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Conducted by MAJOR B. BADEN-POWELL and E. S. GREW, M.A.

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Practical Meteorology.

I.—Temperature of the Air.

By WILLIAM MARRIOTT, F.R.Met.Soc.

IT is curious what vague ideas many people have respecting the weather, and of the instruments employed for recording its changes. The word "glass" is often used indiscriminately for the Barometer and for the Thermometer; and the word "Barometer" is also occasionally used to indicate the Thermometer, and *vice versâ*. It is not supposed that any of the readers of "KNOWLEDGE" have fallen into these errors, but perhaps some information on meteorological instruments and the results derived from their observation may be of service.

We are all affected in some way or other by weather changes, and our feelings tell us when it is cold or warm; but for systematic observation of these changes it is necessary to have a definite standard for comparison, and for this purpose we use the Thermometer.

It goes without saying that everyone knows that a thermometer consists of a fine glass tube with a bulb blown on at one end, and that it is partly filled with some liquid, usually mercury or alcohol, which expands on being heated, and contracts on being cooled. The tube is marked off in degrees so that the changes of the liquid can be measured on a definite scale. The Fahrenheit scale is the one used in this country, in which the freezing point is 32°, and the boiling point 212°. On the Continent the Centigrade scale is generally employed, in which the freezing point is 0°, and the boiling point 100°.

For meteorological purposes the thermometers should be sensitive instruments and of the best construction, and they should be verified at the Kew Observatory in order that their errors may be determined and the necessary corrections supplied. In order to obtain the highest and lowest temperatures self-registering thermometers must be used. The maximum thermometer may be either on Negretti and Zambra's or on Phillips's principle. In the former the tube is bent near the bulb, and the bore greatly contracted; the mercury, in expanding, is forced through this contraction but is not permitted to recede into the bulb on a lowering of temperature. It therefore remains at the highest temperature. In Phillips's thermometer a small air bubble divides the mercurial column, the detached portion remaining at the extreme position to which it has advanced, thus registering the highest temperature.

In the minimum thermometer spirit is employed, and in it there is immersed an index. When the temperature falls the spirit draws the index along with it, but on rising again the spirit passes the index, leaving it at the lowest point to which it had been drawn.

In order that these instruments may indicate as nearly as possible the true temperature of the air, and that the results at various places may be comparable with each other, they are placed in a Stevenson screen, with their bulbs 4 feet above the ground (Fig. 1.) This screen, which is a louvre boarded box painted white, is placed in the open over grass, and away from walls, &c.

In this country it is the recognized custom to read the thermometers at 9 a.m. and to enter the reading of the

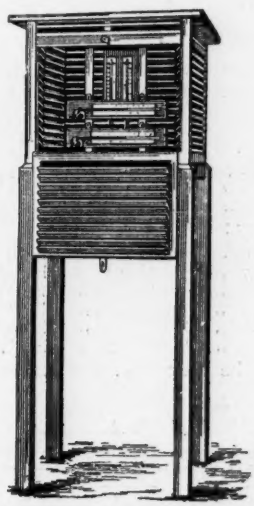

Fig. 1.—Stevenson Thermometer Screen.

maximum thermometer to the previous day. For all practical purposes the mean temperature for the day may be obtained by adding the maximum and minimum readings together and dividing the result by 2, thus: Max. 65·0°, min. 43·0° = mean 54·0°. From these two thermometers we are thus able to obtain for each day the highest, the lowest, the mean, and the range of temperature. They do not, however, indicate at what times the extremes took place, so it is the custom at first-class observatories to employ photographic self-recording instruments for this purpose. Previous to the introduction of photography it was the practice at the Royal Observatory, Greenwich, from 1840 to 1847, for the observers to read the thermometers every two hours, day and night, which was a very laborious proceeding. At the observatory on Ben Nevis *hourly* observations are regularly made, as it is impracticable to employ self-recording instruments in that extremely damp and cold climate.

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The photographic self-recording instruments are very costly, and need special buildings for their equipment, and so can only be employed at first-class observatories. By the introduction, during recent years, of the Richard pattern of self-recording instruments, it is now possible for observers to provide themselves at a moderate cost with a small but useful thermograph, which can be placed in the Stevenson screen, and which will give a continuous record of the changes of temperature for a whole week.

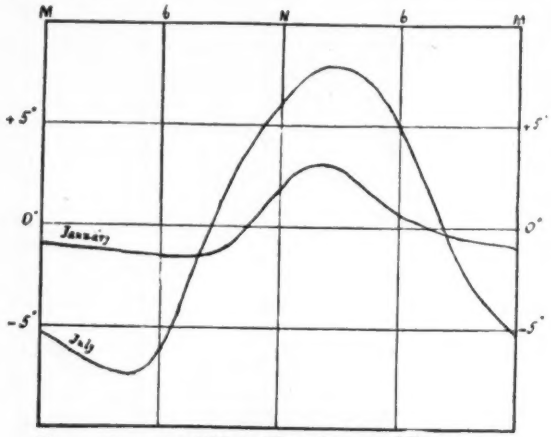

Fig. 2.—Summer and Winter Diurnal Range of Temperature.

The following values show the annual diurnal range of temperature at Greenwich, based on the 20 years' observations 1849-1868, those with the + sign indicating that the values were above, and those with the − below the mean for the day:—

Mid.	− 3°.4	6 a.m.	− 3°.8	Noon	+ 5°.1	6 p.m.	+ 2°.0
1 a.m.	− 3 ·7	7 ,,	− 2 ·6	1 p.m.	+ 5 ·7	7 ,,	+ 0 ·5
2 ,,	− 4 ·0	8 ,,	− 1 ·1	2 ,,	+ 5 ·9	8 ,,	− 0 ·8
3 ,,	− 4 ·3	9 ,,	+ 0 ·7	3 ,,	+ 5 ·5	9 ,,	− 1 ·8
4 ,,	− 4 ·5	10 ,,	+ 2 ·5	4 ,,	+ 4 ·6	10 ,,	− 2 ·4
5 ,,	− 4 ·4	11 ,,	+ 3 ·9	5 ,,	+ 3 ·4	11 ,,	− 3 ·0

It will thus be seen that the temperature is at its minimum just before sunrise, and attains its maximum between 1 and 2 o'clock in the afternoon. Fig. 2 gives the summer and winter diurnal range of temperature.

We might possibly imagine that the temperature would progress uniformly day by day from its lowest point in winter to its greatest height in summer. But such is by no means the case. The variability of temperature is very great.

A striking instance occurred in January, 1901. At Swarraton, near Alresford, Hants, the minimum on the 9th was as low as − 1·9°, but the maximum on the 10th was as high as 49·2°, thus showing a range of 51·1° in two days. In consequence of this great variability, it will be understood that observations must extend over a large number of years before the daily irregularities can be smoothed out. Even 50 years is not long enough to produce a smooth curve, as will be seen from Fig. 3, which gives the mean temperature on every day at Greenwich for the 50 years 1841-1890. This Fig. is reproduced from a paper by Mr. W. Ellis, F.R.S., in the *Quarterly Journal of the Royal Meteorological Society*, vol. xviii., p. 238.

Some of the interruptions in the annual march of temperature are very marked. These are not confined to the south of England, but extend over a much wider area. Dr. Buchan some time ago investigated the temperature of Scotland for a number of years, and showed that the following interruptions occur:—

Six cold periods.	1	Feb.	7-15
	2	April	11-14
	3	May	9-14
	4	June 29-July	4
	5	Aug.	6-11
	6	Nov.	6-12
Three warm periods.	1	July	12-15
	2	Aug.	12-15
	3	Dec.	3- 9

These interruptions are, no doubt, associated with certain types of weather which are accompanied by winds from definite directions. Generally speaking, the effect of the wind is as follows:—

N. winds depress the temperature throughout the year.

N.E. winds do the same, except in summer, when their effect is small.

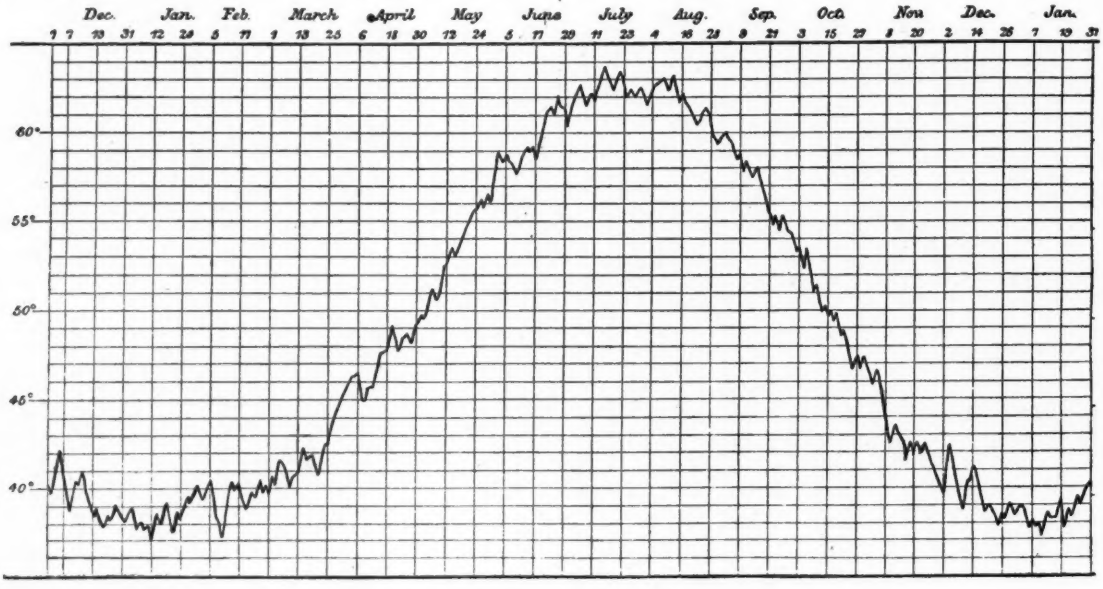

Fig. 3.— Temperature on each day of the year, 1841-1890.

E. winds lower the temperature very much in winter, and generally raise it in summer.

S.E. winds do nearly the same, but less markedly in winter.

S. winds raise the temperature much in winter, but scarcely affect it in summer.

S.W. winds do nearly the same.

W. winds decidedly raise the temperature in winter, and lower it in summer.

N.W. winds lower the temperature generally, but mostly in summer.

The most satisfactory way to ascertain the distribution of temperature over a country is to prepare an isothermal chart. This can be done by plotting on a map the temperatures at a considerable number of stations, and joining up the readings of the same values by lines which are called "isothermals." From an examination of such

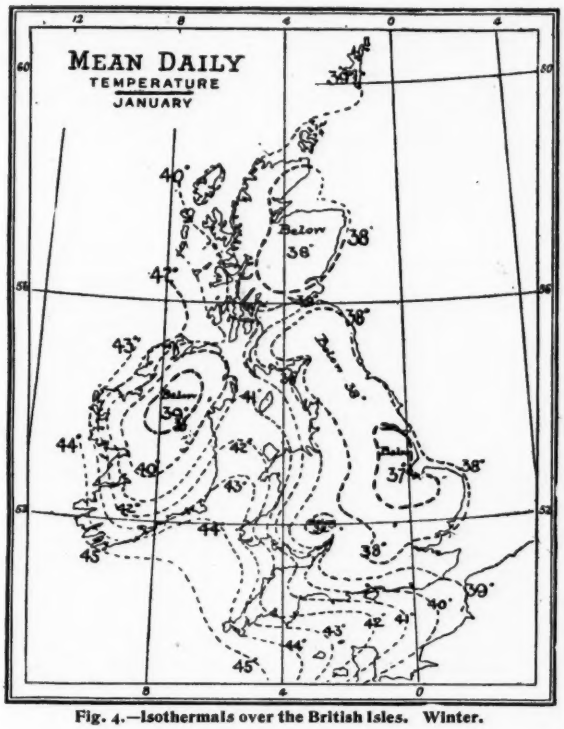

Fig. 4.—Isothermals over the British Isles. Winter.

maps, it is seen that the range of temperature is greater over inland districts than near the coast. The sea has a great equalizing effect on the temperature of the air round the coasts, while inland the ground is warmed up to a greater extent by the sun during the day, and is chilled by radiation at night, and so has a more marked effect upon the air temperature.

Isothermal charts of mean temperature for the British Isles for the winter month of January and for the summer month of July are given in Figs. 4 and 5. These are based on 25 years' observations, 1871—1895, and are from a paper by Messrs. R. H. Scott, and F. Gaster, in the *Quarterly Journal of the Royal Meteorological Society*, vol. xxiii., p. 275.

The influence of the warm water of the Atlantic is very clearly manifest in the January chart in the higher temperatures on the western and south-western coasts than over the central and eastern districts. In the summer the sea has a moderating effect on the air round the coasts; the temperature thus not rising to the extremes which are experienced at inland stations.

The temperature declines with increase of altitude at the rate of nearly 1° in 300 feet; so, in preparing isothermal charts, the temperatures must be corrected proportionately for the height of the station above sea-level. The observations on Ben Nevis give a reduction of 1° in 270 feet. Experimental observations in the free air are now being made with self-recording instruments raised by kites, in order to secure more complete data for determining the rate of decrease of temperature with altitude.

Fig. 5.—Isothermals over the British Isles. Summer.

In the valuable series of meteorological observations which is issued each year from Stonyhurst Observatory a table is published from which it appears that last year's weather, unpleasant and surprising as it was, broke few old records at meteorological stations outside London. It was a year which, as Father Sidgreaves observes, will probaby be known for some time to come as the "wet year," but it was not the wettest known. For example, though its rainfall (at Stonyhurst) was 58.9 in., and 11 in. above the average, it was more than 3 in. below the 62.1 in. of the year 1866; and though rain fell on 231 days, this was not so bad as the 319 days out of 365 on which rain fell in 1872. A fact which emerges from Father Sidgreave's notes, though it is not connected with last year's weather, is that between the highest recorded reading of the barometer in the last fifty-six years, which was 30.597 on January 9, 1896, and the lowest, on December 8, 1886, of 27.350 in., there is a difference of 3.247 in. That we may take to be equal to a difference in pressure on the human frame of not less than a pound and a half to the square inch—not less than a weight of half a ton on the whole human body.

Rare Living Animals in London.

By P. L. SCLATER, Dr.Sc., F.R.S.

II.—The Cape Jumping Hare.

(Pedetes Caffer.)

THIS is, indeed, a rare animal in London, and I believe that the specimen from which Mr. Goodchild has prepared the accompanying sketch is the only representative of the species that has as yet been brought alive to this country.

The "Jumping Hare" of the Cape Colony, the "Spring-haas" of the Boer farmers, is a well-known inhabitant of the high interior plains of South Africa, and has attracted the attention of travellers and settlers there from the earliest times. As long ago as 1778 it was described by the learned Russian naturalist, Pallas, as *Mus caffer*, and shortly afterwards Buffon, in the supplement to his "Histoire Naturelle," gave a fairly accurate account of it as the *Grande Gerboise du Cap*, from notes and sketches furnished to him by Forster. Other well-known authorities on South Africa who have written of it are Sparrman, Thunberg, Le Vaillant, and Burchell, the last-mentioned naturalist having carefully described it in his "Travels in the Interior of South Africa," from observations made in Griqualand West, where, at his time, it was by no means uncommon.

The general colour of the Jumping Hare is tawny brown, becoming paler on the sides and almost pure white beneath. There is also a well-marked white stripe on the body in front of the thighs. The eye is large and the ears are rather long and somewhat pointed; they are thickly clothed with hairs at the base, though nearly naked at their upper ends. The fore-limbs are short, with five pointed toes which are usually carried close to the body and are not very perceptible in the ordinary attitude of the living animal. The hind legs are strongly developed and much lengthened, the tarsus being as long as the foot from the knee to the ankle. There are only four toes to the hind-limb, of which the third is the longest, and all are armed with solid hoof-like nails. The tail is nearly as long as the body (about 20 inches), and is covered with long hairs; it is brown above and paler beneath, with a large terminal black patch.

II.—The Cape Jumping Hare (*Pedetes Caffer*).

The Spring-haas is nocturnal, or, at any rate, crepuscular, in its habits. It lives in small communities on the open veldt, both in the plains and in the mountain-ranges, and makes large and deep burrows in the ground, whence it emerges towards sunset, being rarely seen in the bright daylight. When chased in the open it proceeds in great bounds like a Jerboa or kangaroo, for which its highly-developed hind legs are admirably adapted, and it is even said to move faster up hill than down. Its food is entirely of a vegetable nature, and consists of roots and green stuff of all sorts. Its flesh, according to Le Vaillant, is very good to eat, and in his days was much appreciated by the Hottentots and Caffers.

The Jumping Hare is widely distributed over the open districts of South Africa. In his recently-published work on the Mammals of the Cape Colony and adjacent lands, Mr. W. L. Sclater tells us that it is found throughout the higher and drier districts of the country, extending northwards to Angola on the west, and the Transvaal and Rhodesia on the east, but not apparently occurring in Nyasaland or Mozambique. The South African Museum contains examples of this animal from the Port Elizabeth, Albany, Graaf-Reinet, and Middelburg Divisions of the Cape Colony, and Mr. Sclater states that it is also found throughout the Orange River Colony, the upper part of Natal, Griqualand West, Bechuanaland, and German South-West Africa.

The Spring-haas is very rarely met with in captivity. As already stated the specimen now figured is, I believe, the only one ever brought to England alive, although I have once seen an example in one of the Continental Zoological Gardens. The Zoological Society's specimen was presented to them in 1898 by Mr. William Champion, F.Z.S., of Durban, Natal, and received at the Gardens on March 31 of that year. It has lived in good health and condition ever since, but is rarely to be seen outside of its box in the day-time, unless the keeper be specially summoned to exhibit it.

The Spring-haas has been arranged by some authors among the Murine Rodents and by others near the yerboas, to which it exhibits much superficial resemblance. But there is no doubt that its strongly-marked characters require it to be placed in a family by itself, and Mr. Oldfield Thomas, who has recently published a general revision of the Order Rodentia, has put the Pedetidæ at the commencement of the Hystricomorphine series, which is probably its most natural position. Mr. F. G. Parsons, the author of an elaborate essay on the anatomical structure of *Pedetes* in the Zoological Society's "Proceedings" for 1898, has come to nearly the same conclusion.

PROFESSOR JOHN MILNE has made the suggestion that the displacement of position of the earth's poles, which is of an irregular kind and which can be traced to no known law, may be due to movements of the earth's crust, and that, therefore, the magnitude of the change in position of the poles might be expected to correspond in some way to the number and frequency of great earthquakes. This theory has been reviewed by M. A. de Lapparent, who was the French secretary at the recent International Congress of Academies, in an article entitled "The Wandering Poles," and he finds that the measurements made by the Meteorological Institute at Rome, under M. Cancani, corroborate the Milne conclusions in a remarkable way. Since great earthquakes and earth tremors result apparently from movements that take place in the earth's crust—an ocean bed sinking or a continental mass rising—it seems natural that this factor should contribute effectively to the change and distribution of terrestrial mass, and should, consequently, affect the position of the earth's axis, conjointly with the annual exterior causes. If this conclusion be a correct one, then by observing astronomically the irregularity in movement of the earth's poles we should be supplied with a means of auscultating the variations in the crust of the earth. The science might almost be called the new astrology, since we might perceive in the apparent motions of the stars cataclysmic action, possibly of direct influence on man's destiny, on the earth.

The Later History of the Horse.

By R. LYDEKKER.

IN the January number of *Knowledge* I gave a brief sketch of the gradual evolution of the specialised, single-toed, modern horse—or, rather, of all the members of the genus *Equus*—from earlier three-toed and four-toed mammals of a more generalised type of bodily structure. In that article only a single short paragraph was devoted to the special origin of the domesticated horse, lack of space preventing this important, although exceedingly difficult, aspect of the subject from receiving the attention it deserves. In the present article it is my intention to discuss somewhat more fully the little that is known concerning the history of *Equus caballus*, as the domesticated horse and its immediate wild relatives are termed by naturalists.

During the late prehistoric, or Neolithic, period, when primeval man had replaced the rude chipped flint implements and weapons of his Palæolithic forefathers by a more advanced type, in which the surface was ground smooth and polished, as well as in the Palæolithic period itself, horses are definitely known to have been exceedingly common throughout Western and Central Europe in a wild state. This is fully attested by the abundance of their skulls, teeth, and bones in the superficial deposits of this country, such as the turbary of the Lea Valley near Walthamstow, and a gravel-bed at Audley End, and in numerous caves on the Continent, like that of La Madelaine in France. Although attempts have been made to distinguish two species of true horse from the prehistoric deposits, it seems practically certain that all the remains are inseparable from *Equus caballus*, as typified by the ordinary domesticated horse of North-Western Europe. Careful examination of all available fossil skulls—that is to say, of the specimens in the British and other London museums, as well as the figures of those from Continental localities given in scientific works—indicates, moreover, that the Neolithic and Palæolithic horse agrees with the ordinary modern breeds of Western Europe in the complete absence of any remnant of the depression in front of the eye for the reception of the face-gland or larmier, which forms such a distinctive feature in the skulls of their early Pliocene three-toed ancestors, the Hipparions, and of which a distinct trace persists in their probable immediate progenitor, the extinct *Equus stenonis* of the later Pliocene epoch of this country and the Continent.

Their semi-fossilised skulls and skeletons represent, however, by no means the whole of what we know concerning the prehistoric horses of Western Europe. Primitive man, as represented in this particular instance by the cave-dwellers of La Madelaine, was, fortunately for us, something of an artist, albeit of an extremely "pre-Raphaelite" type, and has left us crude, although unmistakable, sketches of several of the contemporary mammals he was accustomed to hunt or tame, among which are some of the horse. In the main, these rude sketches of the prehistoric horse present a very strong general similarity of type, and portray a clumsy-headed and short-limbed brute, with an upright or "hog" mane, and a rough tangled tail, which was probably only sparsely haired near the root. A couple of sketches of this type are reproduced in figure 1.

XUM

Such Neolithic and Palæolithic horses were evidently very closely allied to the tarpan, or wild or semi-wild horses, which a century ago abounded on the plains of Southern Russia; a nearly allied type still apparently surviving in the form of the wild ponies—the so-called

Fig. 1.—Horses sketched by the Cave-dwellers of La Madelaine.

Przewalski's horse—of the borders of the Gobi desert, which seem to be, at most, nothing more than a local wild or half-wild race of the domesticated horse. In these animals the mane is upright or slightly falling over at the summit, the tail is thin and scantily haired at the base, while the head is heavy and ass-like, and the limbs are short. In colour the Mongolian ponies are dun, with dark brown manes, tails, and legs, and frequently with the muzzle whitish; but the tarpan seems to have been a mouse-coloured animal. Probably the prehistoric horse was very similar in colour to one or other of the two.

Although most of the sketches of the contemporaneous horse left by primitive man indicate animals of the type referred to above, it should be mentioned that a few of these sketches show a somewhat different form; and from this fact it has been suggested by some writers—among them Professor R. Munro,* of Edinburgh, who has lately written on this subject—that two distinct forms of ancient wild horse are recognisable in Western Europe, the one having a smaller head and longer limbs than the other. In some instances we must probably attribute these differences in the sketches of the ancient horse to incapacity on the part of the artist; and this for two reasons. In the first place, none of the skulls of Neolithic and Palæolithic horses that have come under my notice exhibit any differences of the above nature; and, in the second place, judging from what obtains among mammals at the present day, it would be in the highest degree improbable that we should have two closely allied species of true horse inhabiting the same locality contemporaneously. If, on the other hand, we credit the artist with having given correct portraits of two distinct types of true horse, then it is practically certain that the animals he portrayed were domesticated. It should be mentioned, however, that a sketch from the Resslerloch Cave, Switzerland, which has been taken to represent a second species of true horse, is probably intended for the wild ass.

The question as to whether the horse was or was not domesticated by the Palæolithic and Neolithic hunters of Western Europe is one very difficult to answer. From the abundance of its remains in the neighbourhood of stations occupied by contemporary man, it seems well-nigh certain that during the periods in question the horse formed an important article of food; and it has been a natural inference that the animal was kept in a domesticated state by the primitive hunter, as well as pursued for the sake of its flesh. Sir William Flower, for instance, wrote as follows:—

"These horses were domesticated by the inhabitants of Europe before the dawn of history. Cæsar found the ancient Britons and Germans using war-chariots drawn by horses."

This view Professor Munro, in the article already cited, refuses to accept; his opinion being that the horse was never domesticated by the Palæolithic and Neolithic hunters of Western Europe. This opinion is largely based on the rarity of the remains of this animal in English "barrows," or tumuli, as well as in the waste-heaps of the ancient Swiss lake-dwellers. It is also urged that the absence of portraits of mounted men among the sketches left us by the cave-dwellers points to the same conclusion.

To the latter objection I do not think much importance can be attached. The rarity of horse-remains in the tumuli, etc., may be fully admitted as an undoubted fact; but since horses, at least on the Continent, seem to have been used for food at this period, the absence of their bones is, perhaps, just as remarkable whether they were known only in the wild state, or in both the wild and domesticated condition. Here it may be remarked that in "Prehistoric Times," Lord Avebury observes "that the horse was very rare, if not altogether unknown, in England during the Stone age." This, I take it, applies only to the domesticated breed, since it is quite certain that the animal existed in a wild state in Britain at this time. Nevertheless, the sentence is apt to be somewhat misleading, and it is for this reason that it is quoted.

An argument in favour of the domestication of the horse in Western Europe has been drawn from certain sketches found in Continental caves, which have been supposed to represent this animal bitted and bridled. As to the value of this evidence, I do not feel competent to offer an opinion, but I doubt if it can be dismissed by the suggestion (of Professor Munro) that these sketches may depict wild horses being led in halters or lassoes to the home of their captors for slaughter as food. If they be bridled horses at all, I think there cannot be much doubt that they were domesticated. My opinion with regard to the supposed two types of

Fig. 2.—Hog-maned Horse from a Grecian sculpture.

horses represented in other sketches has been already expressed.

Another important point in this inquiry is how we are to account for the origin of the domesticated horses possessed by the ancient Britons and Germans in

* "On the Prehistoric Horses of Europe, and their Supposed Domestication in Palæolithic Times." Proc. R. Phys. Soc. Edinb., 1903, pp. 70-104, pl. i.

Cæsar's time unless they were the descendants of the native prehistoric breed; for it seems scarcely likely that the Britons, at any rate, could have imported a foreign breed. Unfortunately, we know nothing whatever with regard to the physical characteristics of these horses. If the ancient British war-horse were an animal of the type depicted in the Madelaine sketches, there would be little doubt as to its being an indigenous breed, for, as I shall show directly, the domesticated horses of South-Eastern Europe and Western Asia belonged to a long-maned breed of great antiquity.

What we, in fact, really want to know is whether naturally hog-maned horses of the tarpan type were ever domesticated in Europe; and to this question there seems, unfortunately, no possibility of giving a decisive answer.

It has, indeed, been suggested to me that the hog-maned horses represented on the frieze of the Parthenon, which was completed in the year 438 B.C., and those on the so-called Amazons' Sarcophagus, dating from the first century B.C., are animals of this type. And since at least most horses in Greek sculptures from about the year 500 B.C. to the Christian era display similar hog-manes, the suggestion appears at first sight very

Fig. 3.—Long-maned Horses of the Assyrian countries. (From Layard's "Nineveh.")

plausible. I am informed, however, by Mr. Cecil Smith, of the British Museum, that until about the year 500 B.C. the Greek horse is represented with a long flowing mane. About the latter date, or, perhaps, a little earlier, Athenian vases begin to show horses with hog-manes, after which such a type becomes predominant, if not universal, in the sculptures. Etruscan vases, on the other hand, generally show long-maned horses. From this, I think, it is perfectly evident that the short manes of the horses on the Parthenon frieze and other Græco-Roman sculptures are the result of cutting. It follows from this, on the assumption that a long mane is the result of domestication, that the Greek and Etruscan horses belonged to a very ancient breed.

If, now, we direct our attention to the sculptures of horses from Nimrod, Persepolis, and other ancient cities of Western Asia, as shown, for instance, on pages 224 and 225 of Vaux's "Nineveh and Persepolis" (1850), and on the plate facing page 334 (herewith reproduced) of the abridged edition of Layard's "Nineveh," we find that they all have long flowing manes, and tails of such length as to be, in some instances, looped up. These horses, moreover, appear to be of a finer and more Arab-like shape than those in the Greek sculptures. A similar type of mane and tail is displayed in some of the horses depicted in the ancient Egyptian frescoes, as in the one representing the "Tribute of the Arvadites" given on page 67 of Gosse's "Ancient Egypt" (1847). Here the whole shape and make of the horse is decidedly of the Arab type. In some of the other figures of horses in the work last mentioned, as those on page 108, the pendent character of the mane is not so unmistakably displayed, although I think it was the artist's intention to represent this type.

As to the date that horses were introduced among the Babylonians and Assyrians, there does not appear to be any definite record; but from the fact that in the sculptures the horseman when going to war is always represented with an attendant on foot leading his horse and carrying one or more of his weapons, it has been suggested that riding was a comparatively new art. In Egypt the evidence is more satisfactory, as the horse is not represented on any of the frescoes antecedent to the 18th dynasty (about 1900 B.C.), after which it gradually becomes more numerous. In all these instances, it may be observed, the horse is invariably used only for war, or in state processions—never for drawing burdens or in agricultural operations.

The ancient Egyptians doubtless received their horses from Assyria and the Babylonian countries. As to the origin of the Assyrian and Babylonian horses, some difference of opinion has prevailed, but it appears to me most probable that they came from some part of Central Asia, such as the Turcoman countries. They certainly were not derived from Arabia, where the horse is definitely known to have been a comparatively recent introduction. Neither, I think, was Africa the place of origin, as has been suggested by some, for the very sufficient reason that we have no evidence of the existence on that continent of either wild or half-wild true horses at any period.

From the foregoing it would appear that we have decisive evidence of the existence in Egypt so long ago as 1900 B.C., and in the Assyrian countries (if the above inferences be correct) at a considerably earlier period, of a long-maned breed of Arab-like horse totally unlike the wild tarpan or the prehistoric horse familiar to the cave-dwellers of La Madelaine. Such a breed must have been the result either of a long antecedent domestication, or must have been produced from a wild species furnished with a long mane and tail. Probably the former view is correct so far as the development of the mane and tail is concerned, although, as shown below, it is most likely that the breed traces its origin to a species distinct from the tarpan and prehistoric horse of Western Europe.

That such a breed should have been introduced into Germany and Britain in pre-Cæsarian times—at all events, in such numbers as to obliterate all traces of crossing with the wild horses which abounded in those countries during that period—seems to me in the highest degree improbable; and I therefore cannot at present see any valid reason for refusing to credit the view of Flower that in Palæolithic and Neolithic times the indigenous hog-maned wild horses were domesticated by the aborigines.

When advocating this view, Sir William was, however, careful to add that it is "doubtful whether the majority of the horses existing now are derived directly from the indigenous wild horses of Western Europe, it being more probable that they are the descendants of horses imported through Greece and Italy from Asia, derived from a still earlier domestication, followed by gradual improvement through long-continued attention bestowed upon their breeding and training."

In other words, this, broadly speaking, is equivalent

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to saying that at some early period a breed of long-maned horses was introduced from the east into Europe, which resulted in so modifying the original hog-maned stock as to render flowing manes universal; and if this be the case, we have to attribute a mixed, or dual, origin to the ordinary, or so-called "cold-blooded" horses. Traces of the indigenous blood may, perhaps, be detected in the apparently stouter build of the horses of the Greek sculptures as compared with those of the Egyptian frescoes and Assyrian bas-reliefs.

In comparatively modern times another importation of eastern blood is definitely known to have taken place, which, by careful restriction, has resulted in the production of the existing thoroughbred. The Arabs and Barbs from which this thoroughbred strain originated were themselves, in all probability, the direct unmixed product of the aforesaid long-maned horses of ancient Assyria, Babylonia, and Egypt, which we have seen reason to believe arose from a totally different stock to the hog-maned breed of Europe.

With regard to the ultimate ancestor of the thoroughbred and its early Asiatic progenitor, opinions differ. Professor Ridgeway,* of Cambridge, has recently suggested that Grèvy's zebra (*Equus grèvyi*), of Somaliland and North-East Africa, is the probable ancestor of the thoroughbred stock. Such a solution of the question will not, however, I venture to think, commend itself for a moment to competent zoologists, and I need not, therefore, attempt its refutation.

From the occurrence in a horse-skull of eastern origin in the British Museum of a remnant of the cavity for the face-gland of the Hipparions, and of a fainter trace of the same in the skull of the thoroughbred "Bend Or," I have been led to suggest that the thoroughbred and eastern breeds generally may be derived from an extinct Indian species—*Equus sivalensis*—in which this face-gland was comparatively well developed; and that, as might have been expected, eastern horses retain traces of the face-gland cavity, which, as we have seen, has been completely lost by the prehistoric horses of Western Europe, as it is by their presumed cross-bred existing descendants. It must be confessed that the evidence in favour of this theory is at present slender; and the examination of a series of skulls of Arabs and thoroughbreds is necessary to test its probability. As it is, all that can be said in its favour is that it affords a working hypothesis which accords well with the facts.

In conclusion, I may mention that a correspondent has informed me that a few years ago he owned a horse which showed distinct external traces of the face-gland, in the form of a well-marked depression in front of each eye. The horse referred to was believed to have been an Argentine, and if this be true, another very curious point arises. Certain extinct South American horses, constituting the genus *Onohippidium*, are characterised by the enormous size of the cavity for the face-gland, which was no doubt functional. From the condition of their remains they certainly lived till a comparatively recent date; and it is possible they may have survived till the Spanish exploration of South America, for if the horses seen in Argentina by Cabot in 1530 were indigenous (and it is very difficult to understand how they could have been introduced), they must certainly have been Onohippidiums. Could my correspondent's horse have been one of their cross-bred descendants?

* "The Origin of the Thoroughbred Horse." Proc. Cambridge Phil. Soc., vol cxi., pp. 141-143 (1903).

Photography.

Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

Reversal Further Considered.—There is no room for doubt that the developable condition is of a more complex character than it is often supposed to be. Sir William Abney showed some years ago that the result was not uniform, although the time of exposure multiplied by the intensity of the light was constant, if the light intensity varied—that is, the result of the action of an intense light for a short period is not the same as that of a weak light for an equivalent longer time. The action seems to me to be comparable to the difference between the few blows of a heavy hammer and the many blows of a light hammer, though I do not wish to suggest that the analogy is complete. The different effects produced by various forms of radiant and other energy are more especially noticeable when the action is allowed to proceed beyond what would produce a normal result, or when one kind of energy is allowed to follow another. Professor R. W. Wood has distinguished five "types" of reversal (better, perhaps, called *methods* of reversal), namely: (1), ordinary over-exposure, the same light being allowed to continue to act; (2), reversal produced by developing the plate while it is illuminated by lamp-light or feeble daylight; (3), the result of exposure for a minute or two to light between developing and fixing; (4), the Clayden effect, a longer feeble exposure following a short intense exposure; (5), reversal produced by treating an exposed plate with a solution of a bichromate containing nitric acid, drying, and fogging by exposure to candle-light before developing. Professor Wood also found that Rontgen rays prevent the reversal of spark images by candle-light, that is, they negative the Clayden effect; but that the normal effect of Rontgen rays can be reversed by lamp-light. He arranges the following methods of producing the developable effect in order: (1), pressure marks; (2), Rontgen rays; (3), light shock (that is, an intense light acting for a short time, one-thousandth of a second or less); (4), lamp-light; and finds that any one can be reversed by subsequent exposure to any other that follows it in the list, but not by any that precedes it. Mr. Skinner has since observed that radium will reverse electric spark images (analogous to the Clayden effect), and by prolonging the exposure actually obtained a re-reversal. It has been stated that the continued application of Rontgen rays will not produce reversal. I do not know of any record of reversal produced by pressure. Perhaps the first three methods of producing the developable effect given above are unable to cause reversal of the normal result produced by each respectively. We want an experimental investigation of these and similar matters made under more definite conditions than any that have yet been published.

An Effect of Colour Screens.—A question that has been mooted occasionally, is as to whether a colour screen causes the light that it transmits to produce a greater effect (in the production of a developable image) than the same light would without the screen, when for example, the spectrum is photographed. General Waterhouse recently stated that he had found a chrysoidin screen to apparently confer greater sensitiveness to red than the unscreened plate showed.

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Now, according to Professor R. W. Wood, the Clayden effect does not depend on wave-length, but only on time and intensity. It is, however, quite likely that the red screen prevented a feeble general illumination of the plate, and it appears possible that in this way it stopped a certain reversing effect, and so caused the plate to appear more sensitive to the red light. The various results produced by different causes, as detailed above, justify such a suggestion.

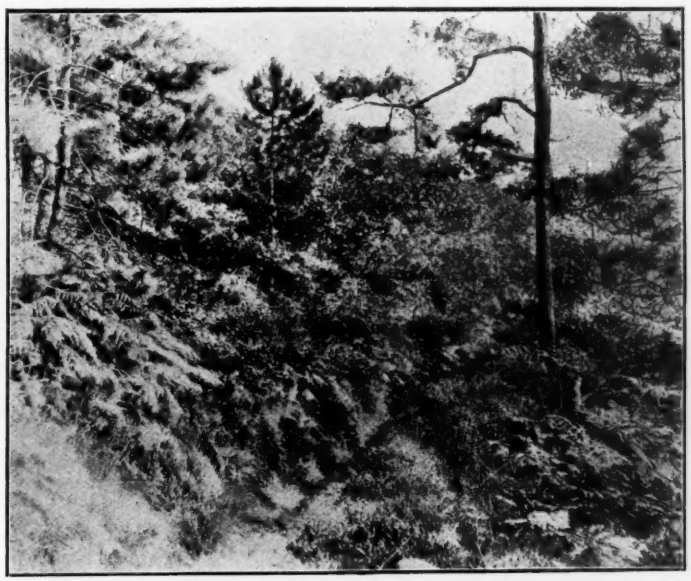
What is Reversed?—One may well ask what is it that is reversed and what is it that is changed in all these experiments? Silver bromide, silver iodide, gelatine, and often potassium bromide are present in the film. It has been suggested, I believe, that there is some occult combination between the gelatine and the silver salts, but there does not appear to be any evidence to support this notion. It has long been known that silver iodide retards the reversal of silver bromide, and this is probably the chief if not the only reason for its introduction into commercial plates. If all the experiments on exposure-effect and reversal referred to were made on plates of known composition, including simple gelatino-bromide films, we should certainly get more information than we have. A given commercial plate is not always the same. All makers strive to improve, and improvement means change. I think, too, that there is very good reason for doubting Professor Wood's time-limit of about one-thousandth of a second for what he calls the "light-shock" effect. Different illuminants and different plates might give other time-limits. My own results that I described last month, obtained by the use of Wynne's shutter-speed tester, indicate that a modification or amplification of Professor Wood's deductions from his experiments is necessary. All the experiments and results here referred to must be regarded as only initiatory.

Ever-Set Shutters.—An "ever-set" shutter has the obvious advantage that it is always ready for use, and that is really the meaning of the word invariably used to describe such apparatus. It would, however, be rather more correct to describe them as never-set, for when an exposure is made the shutter is not released, but the whole movement of the parts that move is effected by pressing the trigger or pinching the ball. The closing is generally effected by springs, in which case the opening has to be done against the pull of these springs. Other things being equal, therefore, an "ever-set" shutter requires more force to operate it than one that is set by a separate operation and merely released for the exposure. If the camera is held in the hand this extra force required means more risk of movement, and if a pneumatic ball is used when the india-rubber or its connections are in a poor condition, it means more risk of failure to operate the shutter. But as is general in such cases, it would be wrong on this account to condemn "ever-set" shutters as a class, for as a matter of fact some of them require very little force to operate them, less, probably, than the force needed to release some of the shutters that are "set" by a separate movement. But the fact remains that the same shutter working under the same conditions will need less force to release it when it is previously set than to operate it without the previous setting.

Peat and its Mode of Formation.

By F. E. FRITSCH, B.Sc., Ph.D.

WHENEVER plant-remains are deposited at a rate which exceeds the rate of decomposition, we get a mass of semi-decayed vegetable substance of a brownish or blackish colour and of soft consistency, which we call peat. Several conditions are necessary to admit of such a deposit being formed, the most important being insufficient drainage (*i.e.*, accumulation of more water than is removed) and lack of the ordinary rapid agents of decomposition. The silting up of a river or of a lake, or the destruction of an area of forest, may both lead to the formation of a swamp, which gradually becomes firmer and drier by the advent of marsh-plants;

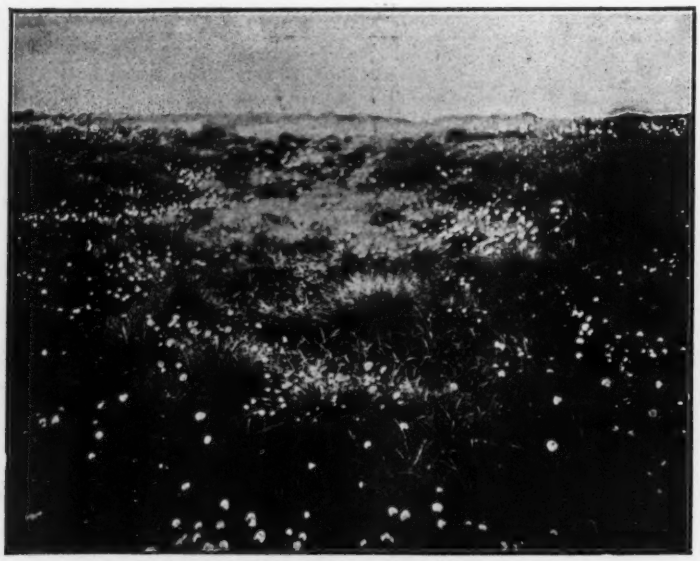


Upland Wood. Heather and Bilberry growing in Peat formed in the Wood.

as their remains accumulate a layer of peat is slowly formed. Under ordinary circumstances all plant-remains are rapidly decomposed by the various organisms occurring in the soil—mainly bacteria, but moulds and a number of animals also take some part in the process. This decay is especially rapid in warmer climates, inasmuch as the growth and activity of the above-mentioned organisms is much increased at higher temperatures, and, consequently, peat is almost unknown in the tropics. In colder regions, however, an abundant vegetation, together with incompetent drainage, is generally too much for the agents of decomposition and, when a layer of peat has once originated in this way, the process goes on more and more rapidly owing to the antiseptic action of the organic acids, formed by the partial decay of the vegetable substance.

Mr. C. E. Moss has recently published an interesting study of the peat moors of the Pennines. A large portion of the summits and slopes are occupied by such moors, which are quite wanting, however, on the steeper slopes, leading down to the lowlands. Three different

types of these moors can be distinguished according to the characteristic plants which grow on them; of these the cotton-grass moors are by far the most extensive with a vegetation in which one of the two species of cotton-grass (*Eriophorum vaginatum* and *E. angustifolium*) are the prominent forms. The other two types of moors occur round the edges of the first, one type being characterised by the abundance of heather (*Calluna Erica*), the other by the essentially grassy character of its vegetation. The cotton-grass moors are richest in peat, which here extends to a depth of 10, or even 20-30 feet, whilst the other two types of moor are much poorer in peat, which is usually not as much as five feet in thickness and often very inconsiderable. When we come to inquire into the origin of these peat-moors, all the evidence seems to point to their being due to the destruction of an original forest. Numbers of place-names occur on the Pennine slopes



Cotton-grass Moor in June. Cotton Grass in Fruit.

which indicate a forest, although the only trace of it, to be found now, lies in the buried timber, which has been found enclosed in the peat. Probably the Roman invasion was the cause of the destruction of a great deal of this primitive woodland, and the fallen logs probably served to dam up a number of the streams, which arose on the hills, and to otherwise interfere with the drainage. The resulting swamps would readily become populated by bog-forming mosses (*Sphagnum*, *Hypnum*), which are always present in the upland woods, whilst the previously existing vegetation would soon be smothered. From such marshy centres the bogs would spread out in all directions and probably even come to occupy ground which was even primarily devoid of forest. After some time the remains of the mosses will have formed a sufficiently consistent layer for the establishment of typical marsh-plants, such as the cotton-grasses mentioned above, and so the entire development of such a peat-moor can be traced. On the slopes of the Pennines the better drainage will not have admitted of such peat-formation, and, consequently, the original forest has here again been more or less re-established. On many of the limestone rocks, which emerge from the peat, a thin layer of this latter is found, and here it may actually be seen in process of formation. The necessary moist basis for the settlement of mosses is in these cases given by a layer of blue-green or green Algæ of a slimy consistency or by the growth of small Lichens. The mosses grow rapidly and form a thin layer of peat of a dry character, on which a slightly divergent flora is usually developed.

The above-described method is no doubt not the only way, in which extensive peat-areas may develop, for the silting up of any fair-sized area of water will, given the suitable conditions, lead to the formation of an extensive moor, and it is by no means necessary that the silting up should be caused by the destruction of woodland. There seems, however, no doubt that the Pennine moors owe their origin to such a cause, and it would be no insuperable difficulty to reverse matters and again let forest cover their slopes. At the present day the huge area of peat is quite neglected, and there appears not to be a single peat factory in the whole district.

ALUMINIUM does not readily lend itself to plating, because the plated metal tends quickly to scale off, and the defect has been attributed to the microscopically thin film of oxide which forms on the surface of the aluminium. A new method of dealing with the metal is to immerse it in soluble fluorides, together with some free hydrofluoric acid; and thus not only to remove the oxide film but to prepare the surface of the aluminium for the reception of a plate of other metal by roughening its surface. The aluminium is then quickly rinsed and immersed in a bath of zinc and aluminium sulphates, and while in the bath a film of zinc is deposited on it by the ordinary methods of electro-plating. Other metals may now be plated on the zinc. An electrolytic film of gold will, however, disappear in the zinc, so that if it is required to give a gold plating to the aluminium-zinc surface this surface must further be coated with copper.

THE German physicist, Dr. Guillaume, has discovered a new alloy, which he has named Invar. This peculiar product is formed of certain proportions of nickel and steel and has the ability to withstand heat without expansion. When made in a certain way it even contracts slightly on being heated. Its importance is easily seen when it is considered that all instruments of precision suffer errors from changes in temperature. Measuring apparatus, and particularly time-pieces, will be greatly benefited; the ability to make a pendulum certain to stay of a constant length, regardless of thermal influence, will be regarded with enthusiasm by astronomers. Other uses have already been found for it, particularly in surveying apparatus. If it is sufficiently reliable to replace the ice bars used in triangulation work, it would effect a great saving in time and money.

The "Panorama" Military Telescope.

By DR. ALFRED GRADENWITZ.

THE field of view of a telescope is necessarily limited, and whenever the observer wishes to inspect the whole of his horizon, he is compelled to turn round his whole instrument, while his body has to follow this rotation.

This drawback is obviated in the so-called "panorama" telescope, where the desired range of

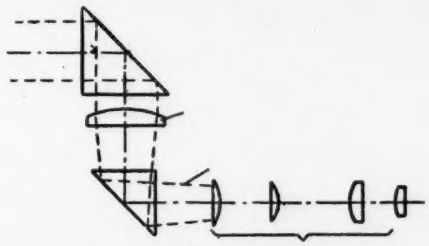


Fig. 1.

vision is secured whilst the eye-piece part of the instrument may remain immovable. It is obvious that the necessary condition for practical use will be that, apart from the magnification produced by the instrument, the observer should receive the same impression of the horizon as if he viewed it with the naked eye. If, therefore, an ordinary telescope, either terrestrial or astronomical, were arranged as represented in figures 1 and 2, with a total reflection prism turning round its

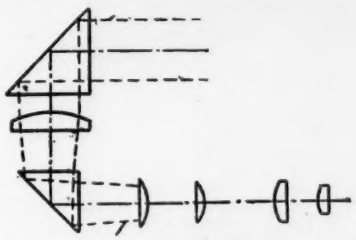


Fig. 2.

vertical axis in front of the objective, in order to obtain the panorama effect, the image produced would undergo an angular distortion equal to the angle of rotation. Anything placed on the top in figure 1 would, after a 180° rotation of the reflection prism, appear to lie below; the image thus being turned also by 180°. The prism combination to be chosen for the internal optical construction of the panorama telescope had, therefore, to fulfil the following conditions:—

1. The image should be erected, simple astronomical eye-pieces being used instead of the awkward terrestrial eye-pieces.
2. The image, whilst exploring the surrounding horizon, should be kept in position, presenting itself to the observer as it would appear to the naked eye looking around.

The Goerz firm has designed several types of panorama telescopes, and the one described below was especially intended to be used as a *pointing telescope* in connection with guns. The optical elements of this combination are shown in figure 3, where A is a total reflection prism, B the erecting prism, C the objective, D a prism separately represented in figure 4, and O an astronomical eye-piece.

The rays from the object, penetrating the prism A, are deflected downwards into the prism B, erecting them in one direction. After traversing the objective C, the prism D will produce a lateral change as seen from figure 4. The image of the object is, therefore, produced at the centre of the eye-piece diaphragm E, in a position corresponding to reality, where it is viewed through the astronomical eye-piece in enlarged size.

The prism B has a square cross section, an important feature being the fact that a rotation by 180° around its longitudinal axis will result in the image being turned by 360°, the image thus rotating at twice the angular speed of the prism. In order, therefore, to obtain an image corresponding to nature, the prism B should be made to follow the movement of the prism

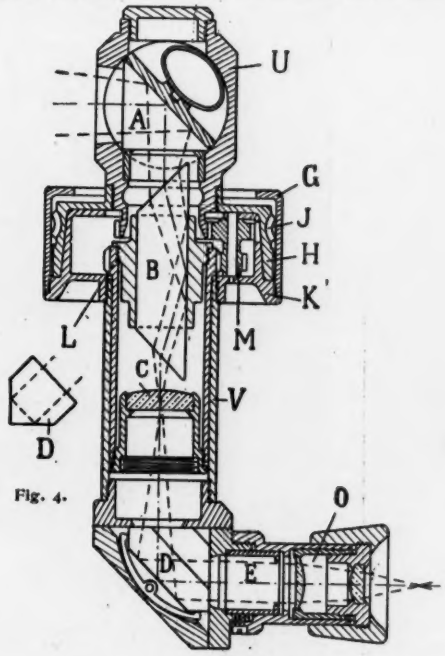


Fig. 4. Fig. 3.

A at half its angular speed. To secure this effect, the latter is inserted into the casing U, being fitted below with a toothing and rigidly connected to the spiral drum H. The latter may be made to rotate on the box K, which is screwed inside to the casing V and outside to the cap G. In the casing V rotates the tube L, being also provided with a toothing at its upper end, and bearing at the top the framing which contains the prism B, and below the objective C. In the two toothings the double pinion M engages, the ratios of gearing being so designed as to impart to the tube L an angular speed of the same direction as that of the prism A and of half its value.

By acting on a screw solidly mounted in the cap G and engaging into the toothing J of the spiral drum H, the reflection prism A and accordingly the prism B, are turned round, thus producing in the field of view the characteristic panorama effect.

In the case of the panorama telescope being used from a protected observing stand, the immovable posi-

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tion of the observer will enable him to choose an observing post of the smallest possible dimensions, thus decreasing the chance of its being destroyed by the projectiles of the enemy. It may be used as pointing telescope for guns in direct or preferably in indirect pointing.

The design of the telescope has obviously to be adapted to the special use it is intended for. While in a stationary observing post a relatively great field of view, a strong magnification, and high accuracy in reading the position of the optical axis are the most important factors, in the case of an instrument used as pointing telescope in connection with a field gun, dimensions as small as possible, light weight, and solid mounting of the lenses and prisms will be of the utmost importance.

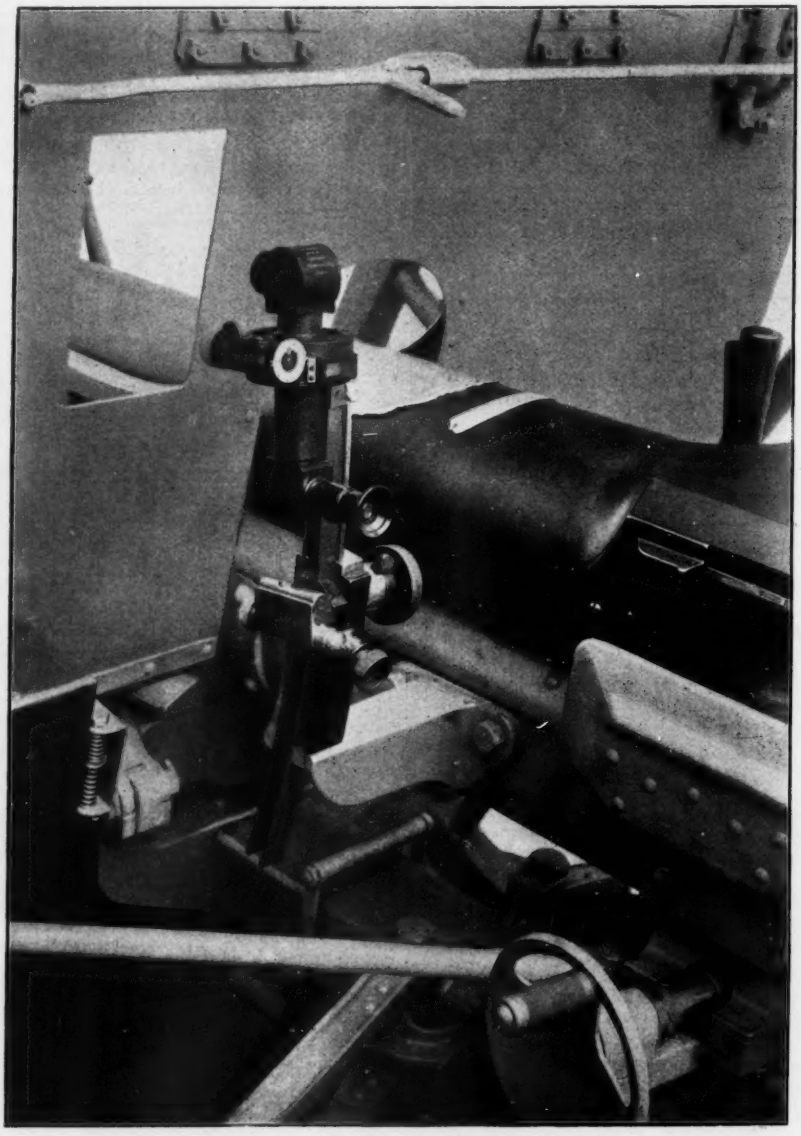

Fig. 5.—The Panorama Military Telescope.

Modern Cosmogonies.

By MISS AGNES CLERKE.

IX.—The Inevitable Ether.

Ether is the fundamental postulate of physics. Its existence, nowise apparent, is in all manner of ways implied. The properties that must be assigned to it are, indeed, arduous of conception. We need the aid of forced analogies to enable us to realise, even imperfectly and indistinctly, the manner in which it discharges functions obviously somehow discharged. But in the last resort, everything is obscure; if our thought-borings go deep enough, they always reach the incomprehensible.

The original ether was the "quintessence" of the ancients—a kind of matter vaguely imagined as pure and incorruptible enough to serve for the raw material of the heavenly bodies, the four common elements being reserved exclusively for sublunary use. The distinction, however, eventually broke down. All the spheres, from the *primum mobile* to the very surface of our low earth, are pervaded by a subtle mode of action, demanding for its transmission machinery of a finer kind than could be constructed out of gross everyday matter. The phenomena of light, when they came to be attentively studied, imperatively required a medium, universally diffused, evasive to sense, accessible only by processes of reasoning. Hooke and Newton accordingly brought the ether through the Horn-gate of dream-land into a region of reality, where it became a subject of legitimate speculation to men of science. The task, however, of definitely specifying its qualities was not taken seriously in hand until the beginning of the nineteenth century, when the establishment of the undulatory theory of light supplied tangible holding-ground for ideas regarding the vehicle of transmission, and rendered the ether a fixture of thought.

A great deal is demanded from it. We cannot afford to set up an establishment of ethers; one factotum must suffice. Incongruous offices are devolved upon it. It has to be Atlas and Mercury in one. It is the universal supporter and the universal messenger. Whatever kind of influence, or form of energy, can pass from world to world, is conveyed by its means. If "action at a distance" be inadmissible (as Newton himself held it to be), the pull of gravity must be exerted through a medium; and common sense insists upon its identification with the transmitting medium of light and electricity. That its dictate is actually complied with is rendered virtually certain by Hertz's discovery that an electric explosion starts an undulatory disturbance indistinguishable, except in scale, from luminous waves; coupled with the indications derived from Mr. Whittaker's recent mathematical researches to the effect that a swifter beat of the same ethereal wings bears the mandates of gravity. The unity of the medium may then be regarded as finally ascertained; the complex interactions of sundry different "fluids" need no longer be taken into account. To provide one with the capabilities implied by the services we perceive it to render is, indeed, a sufficiently formidable task.

In popular apprehension, the ether of space figures as a finer kind of air. No idea could be more misleading. The elasticity by which air transmits the longitudinal waves of sound is totally different from the elasticity by which ether propagates the transversal waves of light. Air yields to pressure; disturbance hence produces in it undulatory condensations due to oscillations of the gaseous molecules along the line in which the audible commotion travels. Ether, on the contrary, appears to be entirely incompressible; it conveys no vibrations directed lengthwise. Now this is extremely perplexing. We have no experience of a kind of matter absolutely rigid to pressure, while yielding, albeit with intense reluctance, to distortional stresses. A jelly-like solid makes the nearest, though a very distant approach to fulfilling the indispensable conditions; and a solid ether was accordingly in vogue until long past the middle of the nineteenth century. For a solid, it had very peculiar qualities; that, for instance, of offering no resistance to motion. It was, in truth, obviously a mere temporary expedient—a scientific fiction which might pass muster until replaced by something corresponding less distantly with the fundamental fact. At last, on the advent of the electro-magnetic theory of light and the modified conceptions which it brought in its train, the solid ether withdrew behind the scenes. Its properties, though inconsistent and unconvincing, had not been chosen arbitrarily; they were imposed by the neccessities of the situation; and when these varied, speculators naturally had recourse to fresh inventions.

The most plausible is that of a medium neither solid, liquid, nor gaseous in the ordinary sense, but in the ideal state of a "perfect fluid." Out of such an ether, Lord Kelvin, with exquisite ingenuity, constructed his "vortex-atoms," which "had their day and ceased to be." Other ideas now prevail. The present tendency of physical science," the late Mr. Preston wrote in 1890,* "is to regard all the phenomena of Nature, and even matter itself, as manifestations of energy stored in the ether." The more closely we look into the things around us, the more strongly the persuasion is forced upon us that what we call ether, electricity, and matter are really varied forms of one primal substance. Two comprehensive schemes of molecular physics, resting upon the basis of this unifying thought, have lately been elaborated, one by Dr. Larmor, the other by Professor Osborne Reynolds. They have nothing in common except the largeness of their synthesis. In every respect they are radically unlike, save in regarding the intangible ether as the one material actuality. Dr. Larmor, however, is not quite confidently explanatory. He presents no cut-and-dried theory of the universe; its haunting mysteries are not ignored in his efforts to rationalise them. Thus, he is vividly aware of the difficulties besetting the endowment of the ether with the type of elasticity which it is rcognised to possess. He can only surmise that it results from particular modes of motion—from "kinetic stability" ensuing upon a special dynamical state. The medium may thus be thought of as pervaded by "a structure of tangled or interlaced vortex filaments, which might resist deformation by forming a stable configuration."† But the details of any such scheme of action are evidently far too intricate to be unravelled offhand; what concerns us here is to point out that no simple, structureless fluid can avail to maintain cosmical communications.

Dr. Larmor's conception of the ether, reduced to its lowest terms, is that of a "rotationally elastic medium."‡ In other words, it resists being turned round an axis. The forces, however, continually acting upon it are of a gyratory nature; and hence arise strains, betrayed to our apprehension by electrical phenomena. Each "electron" is held to be the nucleus of some kind of distortion or displacement,§ and carries with it, as it moves, a field of force. Out of these "point charges," material atoms are variously built up. They are "structures in the ether," encompassed by "atmospheres of ethereal strain," not—as they were formerly taken to be—"small bodies exerting direct action at a distance on other atoms according to extraneous laws of force."¶ Obviously, the new view brings to the front extremely subtle questions regarding the nature of "dynamical transmission"‖—what the propagation of energy essentially consists in, and by what mechanism it is effected; and they are,

* *Theory of Light*, 2nd Ed., p. 28.

† *Encyclopædia Brit.*, Vol. XXV., p. 106.

‡ *Report Brit. Ass.*, 1900, p. 626.

§ *Aether and Matter*, p. 26.

¶ *Nature*, Vol. LXII., p. 453.

‖ Larmor, *Report Brit. Ass.*, 1900, p. 625.

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for the present, unanswerable. Electricity is, on the theory we are attempting to sketch, positive or negative according to the direction of the originating strain. A positive electron might be imagined to resemble a spiral nebula of the right-handed sort, a negative one a left-handed spiral, or *vice versâ*. The analogy is, perhaps, fanciful; yet it helps towards obtaining a mental picture of objects which, insignificant and elusive though they appear, may be the initials and ultimates of this strange world.

The forces, at any rate, by which it is at present kept going, are evoked *ad libitum* by the pioneers of modern research from the ethereal plenum. The actualities of matter are potentialities in the ether. "All mass," in Professor J. J. Thomson's opinion, "is mass of the ether, all momentum, momentum of the ether, and all kinetic energy, kinetic energy of the ether.* Only if this be so, he adds, "the density of the ether must be immensely greater than that of any known substance." The condition is startling, but in dealing with such subjects, we must not be too curious about anomalies. They come, as the ghosts appeared to Odysseus in Hades, at first one by one, then in an awe-inspiring swarm. Yet, in spite of the perplexities they occasion, we can discern with growing sureness of insight the amazing reality of the universal medium. It is, in a manner, the only reality. For what is manifest to sense is subject to change. We can conceive that the visible frame-work of material existence might crumble and dissolve, like "the baseless fabric of a vision," into seeming nothingness. But a substance that is inapprehensible is, to our limited ideas, imperishable. The ether is, indeed, the seat of intense activities, which lie at the root, most likely, of all the processes in Nature. An absolutely uniform medium, however, can scarcely be imagined to energise or react. Some kind of heterogeneity it must possess; and the heterogeneity, produced, in Dr. Larmor's view, by strains, is associated in Professor Reynolds's theory, with structure.

The "Sub-Mechanics of the Universe" are here made to depend upon the fitting together of ineffably small, ideally rigid grains. A misfit gives rise to matter, which might hence be defined as "ether out of gear"; and the misfit can be propagated endlessly from one range of granules to the next. This propagation through the ether of an abnormal arrangement of its constituent particles, without any transference of the particles themselves, explains the phenomena of matter in motion. A concrete existence belongs to the ether alone. It is composed of round, aboriginal atoms, the diameters of which measure the *seven hundred thousand millionth part* of the wave-length of violet light.† They are packed closely together, yet not so closely but that free paths are left to them averaging in length the *four hundred thousand millionth part* of their diameters. This inconceivably small relative motion suffices, nevertheless, to render the medium elastic; is, indeed, "the only cause of elasticity in the universe, and hence is the prime cause of the elasticity of matter." The medium so formed is ten thousand times denser than water; it exerts a mean pressure of 750,000 tons on the square inch; the coefficient of its transverse elasticity is 9×10^{21} (in C.G.S. units); which gives a velocity of transmission identical with that of light for vibrations of the same type, while longitudinal waves are propagated 2.4 times more rapidly. The scheme further includes a plausible rationale of gravity and of electrical effects; so that there is much to warrant the claim of its author to have excogitated "the one and only conceivable purely mechanical system capable of accounting for all the physical evidence, as we know it, in the universe."

The machine, to be sure, lacks motive power; but that is a want which no human ingenuity can supply. Its source is obscured in the primal mystery of creation. And, as regards the preliminary assumptions required for the constitution of an atomic ether, inclined though we might be to cavil at them, we should, perhaps, act more wisely in following Dr. Larmor's advice by abstaining from attempts to explain "the simple group of relations which have been found to define the activity of the ether. We should rather rest satisfied," he tells us, "with having attained to their exact dynamical correlation, just as geometry explores or correlates, without explaining, the descriptive and metric properties of space."‡ Yet one cannot help remarking that the properties of space are not ordinarily modified to suit demonstration, while those of the ethereal medium are varied at the arbitrary discretion of rival cosmogonists. In the future, when they come to be more clearly ascertained, they will, perhaps, form the basis of a genuine new science. Already, the study of ethereal physics excites profound interest and attention. Nor is it possible to ignore the gathering indications that it will impose qualifications upon principles consecrated by authority and hitherto regarded as fundamental. The grand modern tenet of the conservation of energy, for example, may need a gloss; it may prove to be admissible only with certain restrictions. The second bulwark of the scientific edifice is even more seriously undermined. For the "strain-theory" of atomic constitution necessarily includes the conception of opposite distortions corresponding to positive and negative electricity. And the further inference lies close at hand that these, by combining, may neutralise one another. The coalescence, then, of a positive and negative electron should result in the smoothing out of the complementary strains they stand for; and there would ensue the annihilation of a pair of the supposed ultimates of matter. The event might be called the statical equivalent of the destruction of light through interference. That its possibility should be contemplated even by the most adventurous thinkers is a circumstance highly significant of the subversive tendencies inherent in recent research. Already, in May, 1902, Professor J. A. Fleming§ pointed out that "if the electron is a strain-centre in the ether, then corresponding to every negative electron there must be a positive one. In other words, electrons must exist in pairs of such kind that their simultaneous presence at one point would result in the annihilation of both of them." The consequence thus viewed in the abstract finds concrete realisation, if Mr. Jeans's suggestion be adopted,‖ in the processes of radio-activity, which may consist "in an increase of material energy at the expense of the destruction of a certain amount of matter." "There would, therefore, be conservation neither of mass nor of material energy."

No longer ago than at the opening of the present century, such notions would have been scouted as extravagant and paradoxical; now there is no escape from giving them grave and respectful consideration. Scientific reason has ceased to be outraged by hypotheses regarding the disappearance of mass and the

* *Electricity and Matter*, p. 51.

† *The Structure of the Universe*, Rede Lecture, June 10, 1902, p. 14.

‡ *Nature*, June, Vol. LXII, p. 451.

§ *Proceedings Royal Institution*, Vol. XVII, p. 177.

‖ *Nature*, Vol. LXX, p. 101.

development of energy. Mass and energy may, after all, be interchangeable; they are, at any rate, kept less rigidly apart in our meditations than used formerly to be the case. Nor can we assert with any confidence that partial subsidences into, or emergences from, the surrounding medium is for either a sheer impossibility; the universal framework, on the contrary, presents itself to us in the guise of an iridescent fountain leaping upward from, and falling back towards, the ethereal reservoir.

To the very brink of that mysterious ocean the science of the twentieth century has brought us; and it is with a thrill of wondering awe that we stand at its verge and survey its illimitable expanse. The glory of the heavens is transitory, but the impalpable, invisible ether inconceivably remains. Such as it is to-day, it already was when the *Fiat Lux* was spoken; its beginning must have been coeval with that of time. Nothing or everything according to the manner in which it is accounted of, it is evasive of common notice, while obtrusive to delicate scrutiny. Its negative qualities are numerous and baffling. It has no effect in impeding motion; it does not perceptibly arrest, absorb, or scatter light; it pervades, yet has (apparently) no share in the displacements of gross matter. Looking, however, below the surface of things, we find the semi-fabulous quintessence to be unobtrusively doing all the world's work. It embodies the energies of motion; is, perhaps, in a very real sense, the true *primum mobile;* the potencies of matter are rooted in it; the substance of matter is latent in it; universal intercourse is maintained by means of the ether; cosmic influences can be exerted only through its aid; unfelt, it is the source of solidity; unseen, it is the vehicle of light; itself non-phenomenal, it is the indispensable originator of phenomena. A contradiction in terms, it points the perennial moral that what eludes the senses is likely to be more permanently and intensely actual than what strikes them.

PURE science has usually, at all times and in all countries, been poorly paid, and we are reminded by an article by Father Tondorf in *Popular Astronomy* that the great Kepler had to supplement pure astronomy by doubtful astrology. Kepler did not believe in astrology. "Your error," he writes to a friend, "is one common to the greater part of the school of doctors, who fancy that fortunes drop from the skies. Naught comes thence save light"—but he had to supply horoscopes in order to supplement an insufficient income. Some of those who applied to him for predictions from the stars were half convinced with him that Astrology was the "foolish little daughter of Mother Astronomy," as witness the following letter to Kepler from Zeheutmeyer, secretary of Baron von Heberstein: "You are a man busied in scientific investigation and in reading the future in the stars. Please inform me whether these heavenly bodies indicate anything in particular regarding this section of the country. The Baron, my dear sir, is extremely anxious to give you, a man of such authority, a say in this matter. I am far from ignorant of your conviction that nothing can be foretold with certainty; in fact, that the science of astrology is a vague and treacherous art. However, you know how man hankers after news, and how he would have nature forewarn him of the future. I pray you, then, send me something. Harbour no fear. What you send shall be considered strictly confidential."

Sunspot Variation in Latitude.

By WILLIAM J. S. LOCKYER, M.A., Ph.D.

IN the Astronomical Notes in this journal for July reference was made to a very brief discussion which took place at the Royal Astronomical Society on June 10 on the above subject. As this note seems to suggest that

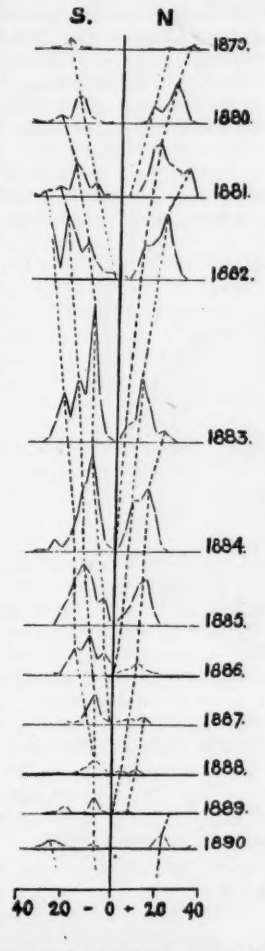


Fig. 1.—The dotted lines indicate the loci of movement of the individual maxima of spotted area or the *spot-activity tracks*.

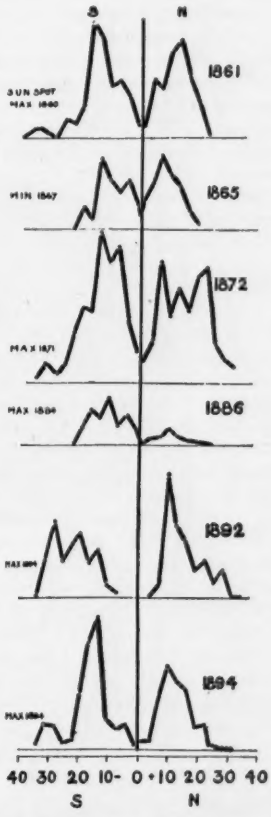


Fig. 2.—Some typical curves, showing the distribution of spotted area per 3° zones.

the results I have published (Roy. Soc. Proc. vol. 73, p. 142) are entirely in disagreement with those set forth by Father Cortie, perhaps I may be permitted to make the following remarks:—

Mention may first be made as to the meaning of the term "spot-activity track," which I think has been somewhat misunderstood by both Father Cortie and Mr. Maunder. The accompanying figure (Fig. 1), which includes a complete sunspot cycle, may, perhaps, help to make this term clearer. Each pair of curves above each horizontal line represents the variation in latitude of spotted area throughout a year as determined by summing up the spotted area for each

zone of 3° in width, using the values for each degree of latitude as published by Greenwich Observatory. A glance at those curves will show :—

(*a*) that many of them have more than one individual maximum;

(*b*) that these individual maxima do not always remain from year to year in the same position as regards latitude (though sometimes they do maintain the same for two, three, or four years together as can be gathered from the curves in my paper).

By joining up these maxima from year to year there appears to be a general drift from high to low latitudes; that is, the positions of the regions (zones) in which the spotted area is greatest change from year to year in a direction towards the equator. These lines of drift of the individual maxima, or their loci of movement towards the equator, are the *spot-activity* tracks. They are *not* tracks on the solar disc as seems to have been inferred.

An argument greatly in favour of this method of treating these multiple points of maxima individually is that we have a needed explanation of the anomalies, pointed out by Spoerer and Braun, of the mean latitude curves. The accompanying figure (Fig. 2) will give the reader some idea of the distribution of spotted area for several selected years, showing that although the spotted area extends over broad zones there are prominent subsidiary maxima included in those zones which should not be neglected. Against each of these pairs of curves the date of the nearest sunspot maximum or minimum has been inserted.

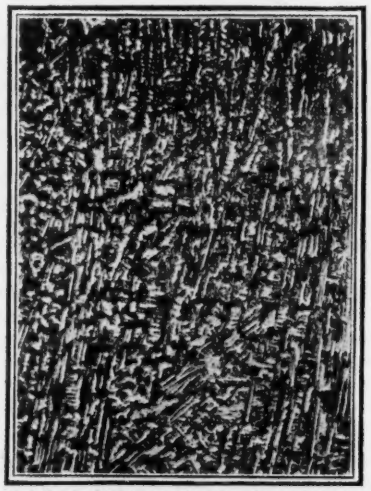
The writer of the note is quite in error when he says that Father Cortie showed "that the limiting latitudes for large sunspots rose from minimum to maximum instead of falling in the manner described by Dr. Lockyer." Father Cortie rather corroborated than opposed my result. As a matter of fact I pointed out, as one of the main results of my investigation, that outbursts of spots in high latitudes are not restricted simply to the epochs at or about a sunspot minimum, but occur even up to the time of sunspot maximum, and further, that there was a tendency after a sunspot minimum for each successive spot-activity track to make its appearance in latitudes higher than those just preceding it. This result I considered important since it was not in harmony with that which would be expected by Spoerer's Law, *i.e.*, that the highest spot latitudes occur about the time of sunspot minimum when a new cycle is in process of commencement.

"Notes on the Composition of Scientific Papers" (Macmillan and Co.), by Dr. T. Clifford Allbutt, Regius Professor of Physics at Cambridge, have been compiled in the hope of improving or forming the literary style of scientific students. In the course of the year Professor Allbutt tells us, in his humorous and engaging preface, he has to read some hundred theses for the degrees of M.B. and M.D.—"in composition a few are good, the greater number are written badly, some very ill indeed," so as "to obscure, to perplex, and even to hide or travesty the sense itself." It is difficult to say how far a sense of style can be imparted, but Professor Allbutt gives sound and excellent advice on the use of words and the construction of sentences, which might with advantage be taken to heart by others than scientific students.

"The Honey Bee" (Houlston and Sons), by T. W. Cowan, F.L.S., F.G.S., F.R.M.S., the well-known authority on bee-keeping, has reached a second edition. This comprehensive little volume, with its elaborate diagrams and illustrations, is valuable alike to the student and the bee-keeper.

The Birth of Crystals.

THE researches of Dr. Otto von Schrön, Professor of Pathological Anatomy in the University of Naples, gave meaning some ten years ago to the expression "the living crystal." He showed that living matter, largely albuminous in character, takes the crystalline form, and, while still living and crystalline, obeys so many of the laws and manifests so many of the properties of inorganic crystallisation that its crystalline character may be said to be established. From these experiments he drew the inference that crystallisation in its terrestrial origin was a manifestation of life—of vital energy. In short, that a crystal grew for the same reasons that a plant grows, or the brain grows, or an amœba grows; that the vital forces stirring the one are no more than a different form of the forces that develop the other. The "living crystal," the "vital crystal" which, for example, he discovered as one of the products evolved by various of the bacilli that he

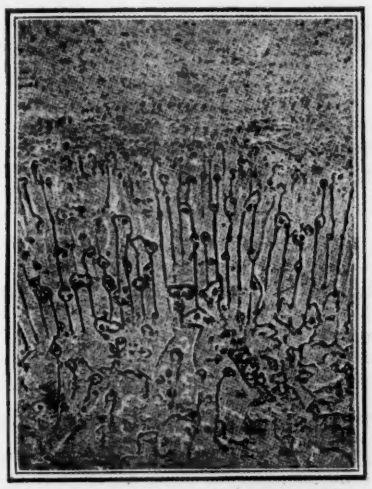


Alum in the Precrystalline state, showing appearance of lines of direction marking future axes. Enlargement, 280.

examined, became thus, in his theory, the bridge between what had heretofore been called living matter—animal and vegetable—and dead matter—mineral. The first crystals which set him on the road to this theory were the crystals of the Asiatic cholera bacillus, which he examined as long ago as 1886. They were long, needle-shaped prisms. Other bacilli examined exhibited distinct crystals of different forms. The *bacillus subtilis*, for instance, formed bayonet rhombs; the *bacillus tenuæformis* hexagonal prisms; the tubercle bacillus develops square rhombs; anthrax, elongated rhombs; any given bacillus being immediately identified by its crystal, which never varies in the shape assumed in its original formation. These objects are perfect crystals in form; yet, as anyone may see, they are alive, and their life, their motion, and their reproduction are as visible and undoubted as their death when it ensues is undoubted. Their death occurs when all the living matter which originally formed part of the crystal has eliminated itself. On death they become the crystals that we know, ordinary mineral crystals.

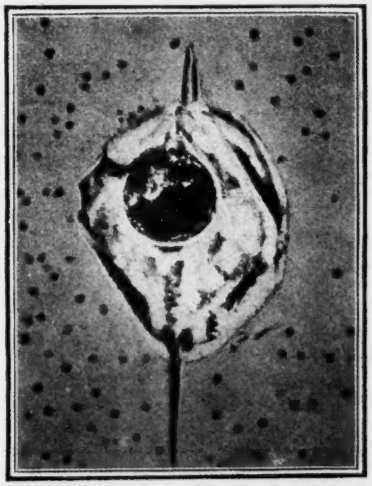
Such were the beliefs and theories, rather freely stated, of Von Schrön; and their interest at the present time lies in the re-statement by MM. F. di Brazza

and P. Pirenne in the *Revue Scientifique*, of the hypothesis that crystals have a kind of life, of a lower grade than that of plants, but still real life. These writers found their theories on phenomena observed under a microscope during the growth of a crystal from a solution. These phenomena have several features in common with the growth of a living cell.



Salicylic Acid in Precrystalline state, showing birth of multipolar cellules resembling nerve cells. Enlargement, 280.

If we dissolve salt in water until the liquid is saturated and then modify the conditions by lowering the temperature, we see crystals of the dissolved salt appear. The process apparently simple, and dependent on easily-stated chemical and physical laws, appears none the less to originate in a series of



Large Petro-cellule of Quartz, showing two protoplasmic substances, and nuclear petroblast. Enlargement, 750.

phenomena that have a remarkable similarity to vital phenomena. According to MM. di Brazza and Pirenne: "At the beginning of the crystallisation a tiny globule is seen to be differentiated from the uniform mass, being easily recognisable on account of its difference in refractive power. Studied closely, this globule shows within it a slight 'petroplasmic network,' which shows an analogy with the formation of animal and vegetable cells. . . . . .

"Then are seen appearing in the network small obscure points called 'petroblasts,' which, when observed under high magnifying power, seem to be at the centre of a dark substance called 'deuterolithoplasm,' and on the periphery of another clearer substance named by Von Schrön 'protolithoplasm.' The formation of the crystal results from these two substances. . . Crystals have different origins, but . . . the petroplasmic kind is by far the most common. In the strife between the two substances constituting the petroblast, the globule changes form by an annular enlargement; the ring then is deformed and an angle is formed which Professor von Schrön calls the 'primitive dominant angle,' because it gives the direction of the future crystal. Soon a second angle forms opposite the first, called the 'diagonal angle.' Finally the meeting-points of these two opposed angles form new angles called 'secondary.' . . . . . .

"The crystal, whose formative phases we have thus studied, can move about, and also presents the

Salicylic Acid in Precrystalline state, showing numerous petroblasts with nuclei. Enlargement, 610.

peculiarity of being able to reproduce itself in three ways—by division, gemmation, and endogeny.

"1. By division. If we take, in special conditions, a crystal of recent formation, we shall see it separate into two individuals which draw apart with a rotatory movement.

"2. By gemmation. The phenomenon takes place in the following manner: the petroblasts develop, reach the surface of the crystal, continue to develop, and are detached, causing waves around the crystal.

"3. By endogeny, the most original case. A little crystal forms inside the mother crystal, comes to the surface and issues from it with a double movement of progression and rotation.

"Life in crystals can be explained by the struggle for existence, which is ardent even here. In fact, if during their growth two crystals come into contact, the weaker will completely disappear, absorbed by the stronger. . . . The crystal seems actually to be a living being, and, as we have said, it should have its special pathology. This is really the case, according to Von Schrön, who has discovered fifteen kinds of disease in crystals, some of which are hereditary—cases of bifurcation, torsion, and erosion, which are confirma-

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tory of the new theory. When its vital cycle has been complete, the crystal then becomes old and is fossilised. It is then inert."

What is the origin of the little globules whence, as has been stated above, all crystals arise? Have they germs or seeds of some kind? Von Schrön thinks not. He regards the inception of the crystal as real spontaneous generation. M. di Brazza, however, criticises this attitude. He asks:

"Why can we not ascribe to the molecule, this infinitely small constituent part of things, the primary generative faculties and substitute for the formulæ of Redi and Virchow* a new one: *Omne vivum ex molecula* [all life from the molecule]?"

This hypothesis the writers submitted to Von Schrön, who reaffirms his belief that the crystal has absolutely no pre-existing nucleus, molecular or other, in the solution in which it arises.†

* *Omne cellula e cellulâ.*

† Professor Von Schrön remarked in his earlier papers that in the preparation and development of bacilli four products were evolved. They were—i., a colourless liquid which forms the envelope about the spore-forming bacillus; ii., gas; iii., irregular masses of albumen; iv., crystals.

Obituary.

DR. ISAAC ROBERTS, F.R.S.

IT is with exceeding regret that we have to record the sudden death on Sunday, July 17, of Isaac Roberts, D.Sc. (Dublin), F.R.S., F.R.A.S. There is no need to tell the readers of "KNOWLEDGE" of the contributions which Dr. Roberts made to the science of astronomy by his photographs of stars, clusters, nebulæ, and comets. Many of these he published in its pages, and his last contribution—three beautiful presentations of Comet Borelly (c 1903)—in the October number of last year, must be fresh in the minds of all. Since 1890 he devoted himself almost entirely to astronomy at his residence, Starfield, Crowborough, where he built an observatory, equipped with a 20-inch reflector and a 5-inch Cooke refractor. In earlier years he had also made a study of geology, and was elected a Fellow of the Geological Society in 1870. In 1882 he was elected a Fellow of the Royal Astronomical Society; he served on its Council for some years, and was awarded its gold medal in 1895 for his astronomical researches. In 1890 he was elected a Fellow of the Royal Society, and in 1892 the University of Dublin conferred on him the hon. degree of Doctor of Science. In October, 1901, he married Mdlle. Dorothea Klumpke, D.-ès-Sc., who had previously been head of the Bureau for measuring the plates of the International Catalogue in the National Observatory at Paris. In 1893 and 1899 he published two volumes of photographs of star-clusters and nebulæ, photographs which, if his work is continued, will afford ere long evidence of the nature of the changes which are going on in the stellar universe. Dr. Roberts was born in 1829.

CAPTAIN WILLIAM NOBLE, F.R.A.S.

ENGLISH astronomy has suffered a very grievous loss in the death of Captain William Noble, of Forest Lodge, Maresfield, Uckfield, Surrey. He was born in 1828, and for some years was a member of the Rifle Brigade, and after his retirement from the service he took an active interest in the politics and business of his county, being a Justice of the Peace for many years before his death. He took a great interest in many scientific subjects, but his chief pursuit was astronomy, and he was elected a Fellow of the Royal Astronomical Society on June 8, 1855, and served on its Council with but short intermissions from 1867 until 1902. He was an original member of the British Astronomical Association, was its first President, serving from 1890 to 1892, and contributed largely to its success. He communicated many papers to the "Monthly Notices" of the Royal Astronomical Society, to the "Journal" of the British Astronomical Association, to the "Observatory," to "KNOWLEDGE," and to the "English Mechanic." To the last periodical he contributed for many years a fortnightly letter, under the signature of a "Fellow of the Royal Astronomical Society." He had also the author of "Half-Hours with a 3-inch Telescope," a book of great practical value and aid to amateurs beginning a study of the Moon and planets. He was himself a good observer, and his drawings of Jupiter and Mars and of portions of the Moon are both truthful and accurate. He was a most engaging personality. It was not only that he took an interest in astronomy and the work of astronomers, but he manifested his interest in a breezy and genial fashion. He had always ready to help by word or letters the novice in the science that he himself loved. His death took place on Saturday, July 9, 1904.

PROFESSOR THEODOR BREDICHIN.

PROFESSOR THEODOR BREDICHIN died on May 14, 1904, after a short illness. Russia has lost in him her most eminent astronomer and the one who has had most influence on the development of astronomy, both as Professor and as Director, successively, of the two largest Russian observatories—Moscow and Pulkowo. He was born on December 8, 1830, in Nicolaieff, and was educated first at the Richelieu Lyceum in Odessa, and then in the University of Moscow. He was elected Professor of Astronomy at the University in 1857, and in 1873 was made Director of its observatory. Here he initiated observations of stellar spectra, of the places of stars, and the determination of gravity through observations of pendulums. But his great work was his research on the forms of comets with which was connected his theory of meteors. In 1890 he succeeded O. Struve as Director of the great Pulkowo Observatory, and here he remained until 1894, when he resigned his Directorate and retired to Petersburg to pursue his cometary investigations. He was elected a foreign Associate of the Royal Astronomical Society in 1884.

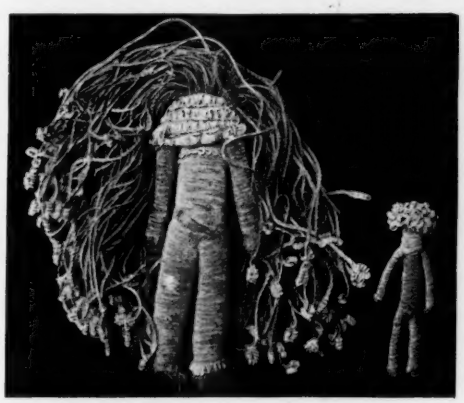
AT the Royal Society's conversazione was exhibited a little instrument devised by the Hon. R. J. Strutt and called a radium electroscope, in which the departure of negative ions from a speck of radium enclosed in a sealed vacuum tube perpetually charges the leaves of an electroscope also inside the sealed tube. The action is probably not perpetual, but so long as the radium lasts, say 30,000 years, the tiny leaves of the electroscope will go on opening and shutting so many times a minute, like a clock or a perpetual motor. But this spectacular form of motion is not the limit of the radium electroscope's potential activities. Mr. Harrison Glew has devised an arrangement by which the periodical discharges of the electroscope, when the leaves touch the side of the sealed glass tube (in which a wire connects two inner coatings of zinc foil to earth), rings a bell or prints a record of every contact of the leaves. Each discharge from the outside terminal of zinc foil and wire, when the leaf strikes the inner foil, is sufficient to act on a "coherer" similar to that which is used in wireless telegraphy. The "coherer," as in a wireless telegraphic system, is put in a bell circuit, and each time it is acted on, as it might be acted on by a train of Hertzian waves, it rings a bell. In Mr. Glew's experiments, with a three milligrammes speck of radium, the bell was rung every seventy seconds. Thus we might devise a perpetual "minute bell."

XUM

The Dolls of the Tombs

The Beni Hasan Excavations.

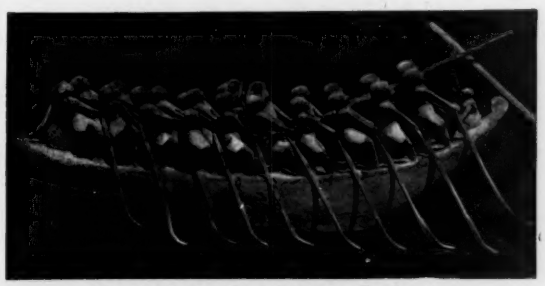
By the kindness of Mr. John Garstang, director of the Beni Hasan Excavations, we are able to reproduce some photographs of the extraordinarily interesting models and the fascinating dolls which have been found by him in the excavated tombs of Beni Hasan. Our thanks are also due to the Council of the Anthropological Institute, in whose journal, *Man*, May, 1903 and July, 1904, the photographs have already appeared. These models, placed in their rocky tombs 4,000 years ago, were recently exhibited at the Society of Antiquaries' Rooms, Burlington House, and proved without doubt the most attractive archæological exhibition of the year. Some of the models have been shown in London before, and Princess Henry of Battenberg was an interested visitor, not at Burlington House alone, but at the excavations themselves in Egypt. The attraction of the dolls is of a double kind. It lies not only in the knowledge that they are the handiwork of 4,000 years



String Dolls. Tomb 420.

ago, or that they represent the life of those times as well as the probable superstition that the presence of such dolls in tombs ensured for the human body buried there the company, assistance, and service of slaves, soldiers, and equipment in the Paradise where the soul had gone ; but it is to be found also in the extraordinary vividness of the dolls themselves. They are sometimes rudely carved, but they are always lifelike. There are dolls in granaries and dolls in war-galleys—wonderful dolls these, with a world of expression in their glaring eyes, though the eyes are only two dashes and a dot—and a wonderful vigour in the way their wooden arms strain at the sweeps. You can almost hear the yell of the steersman and the crack of his whip. Then there are dolls baking, kneading, butchering ; and a wooden bullock with meek legs bound together is ready decorated for the sacrifice. The wooden priests stand near with wooden gestures of uplifted piety. In one galley the dolls are playing chess! Then there are dolls of historic interest ; the dolls that point to a Libyan irruption and a renaissance of new ideals in the art of dolls ; and a beautiful wooden portrait doll, with an archaic smile on his well-cut lips and determination writ plainly on his jaws and fist. Lastly, there are the real dolls of that forgotten day, dolls that were made of string and had curly locks of threaded beads—such were the dolls that little Neith-Hetep or Ayesha played with 4,000 years ago.

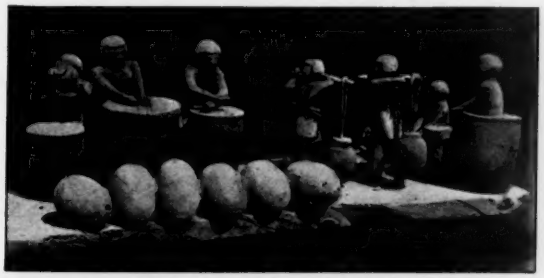
Of the excavations, Mr. Garstang writes :—" It was early in December, 1902, that excavations commenced in the vicinity of Beni Hasan. The site is on the east bank of the Nile, where the river approaches somewhat closely to the limestone cliffs that bound the valley, some fourteen miles southward from Minia, a great



Rowing Boat of Twenty Oars. Tomb 116.

town of Middle Egypt. The site has long been famous for its long gallery of Middle Empire tombs, which are hewn in the living rock, well up the slope. These are decorated in their interior with scenes, painted with realism upon the dressed surface of the walls, which are the more interesting in that they represent, in many cases, incidents of daily life in the home and in the fields, as well as the rites pertaining to the dead, in the age to which they belong, more than 2,000 years B.C. Historically they belong to the feudal period of Egypt, when the Government was in the hands of powerful chieftains—hereditary owners of the soil, and they bridge over the intervening years during which the monarchy slowly regained its authority, and was finally re-established by Amenemhat III.

These great rock-hewn chambers, for the most part, indicate the burial places of these feudal lords, whose great sarcophagi were placed in small recesses at the foot of deep square shafts within them. It might have been suspected that the court officials of these great chieftains, who kept up regal pomp, would seek burial in the same vicinity ; and that the tomb furniture and burial deposits placed with them might illustrate more fully the civilisation and culture of the age : such was,



The Making of Beer. Tomb 116.

indeed, the quest of this expedition. The necropolis was discovered ranging along the face of the cliff, just below the famous gallery ; and 887 tombs were found and excavated during the two years' work. The presence of these was already indicated, indeed, by the numerous open mouths of shafts sunk in the limestone.

The first tomb discovered and entered gave an indica-

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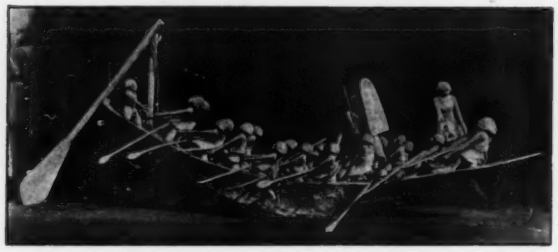
tion. The shaft had been found filled by design with large masses of rock and the door of the chamber was closed with rough-dressed stones built up like a door. On removing these the interior showed the tomb of a courtier named Antef, undisturbed and preserved in its entirety as it had been left by the ancient Egyptians at his funeral, 4,000 years before. The wooden sarcophagus, with its lines of religious formulæ and text painted in hieroglyphic character upon it, lay within, head to the north, and the painted "eyes of Osiris" towards the east. Upon it, and by its side,



Boat with Armed Man.

were little wooden models of river and sailing boats, a granary, a group of persons baking, a man brewing, another leading an ox, a girl carrying a brace of birds in her hand and a basket on her head. The oarsmen still clinging to their oars, through all the lapse of years, and the paint was fresh upon the wooden figures. It was a wonderful sight; one which rewards a lifetime. Within the sarcophagus were the bones of Antef, wrapped around with a linen cloth, which was still preserved, while the body had decayed. His pillow, a wooden one, was by his head, and a pair of sandals at his feet.

This first tomb entered proved characteristic of the whole number, and the result is a wealth of information as to the life and ritual of the Egypt of that distant day.

NOTES.

ASTRONOMICAL.

A Possible Variation of the Solar Radiation.

THE *Astrophysical Journal* for June opens with a paper by Professor S. P. Langley, in which he shows cause for concluding that there was probably a fall in the solar radiation at the end of March, 1903. The determination of any such variation in the solar constant is one of extreme difficulty owing to the great and varying effects of the absorption exercised by our atmosphere, and Professor Langley puts his results forward with all due caution. But the introduction of automatic methods for registering the observations of the bolometer, and improvements in the instrument itself, so that the zero of the galvanometer remains almost unchanged for weeks together, justify the attempt to ascertain if any such variation can be detected. The chief difficulty lies in the calculation of the total absorption exercised by our atmosphere so that the radiation recorded at the observing station may be corrected so as to exhibit the radiation as it would be recorded were the atmosphere removed. The only method at present available is by the comparison of observations made with the sun at different altitudes, and acting through different thicknesses of air. The measurement and reduction of a series of from five to ten bolographs of a single day involves so much labour that a single computation of the solar constant takes about a week. The effects due to the atmospheric absorption having been allowed for, a series of observations made at the Smithsonian Astrophysical Observatory, from October, 1902, to March, 1904, appears to show that the solar radiation itself fell off by about 10 per cent., the change beginning late in March, 1903. Such a change should be followed by a decrease of temperature on the earth less than 7·5° C., and on comparing the observed temperatures at 89 stations in the North Temperate Zone, an average decrease of temperature of over 2° C. was actually found to be shown; stations far from the retarding influence of the oceans showing the greatest variation. The mean temperature curve of the 89 stations shows a striking correspondence with the curve of the solar constant during the first 8 months of 1903, but rises in the last 4 months. This rise may be due to an increase in the transparency of the earth's atmosphere, the Smithsonian observations indicating that there was a great falling off in such transparency from February to August, 1903, but a recovery later, though the maximum value recorded in 1901-2 was not fully attained.

* * *

The Electric Equilibrium of the Sun.

An important paper by Professor Svante Arrhenius was communicated to the Royal Society on June 2 by Sir William Huggins. Professor Arrhenius had previously pointed out that several electric and magnetic phenomena might be connected with the pressure of radiation. The gases in the solar atmosphere are practically ionised by the ultra-violet radiation; the negative ions condensing vapours more easily than positive ions. A large majority of the droplets formed by condensation in the sun's atmosphere are thus negatively charged and driven away, charging with negative electricity the atmospheres of celestial bodies, *e.g.*, the earth, which they meet. Calculating the speed with which these particles will move through space, Arrhenius finds that on the average they would reach the earth in about 46 hours. Now Ellis and Maunder have shown that the magnetic storms commence 26 hours in the mean after the sun spots which probably cause them reach the central meridian of the sun. Riccò found that the height of the storm is attained on the average about 45·5 hours after the transit of the spot; a result practically coinciding with that of Ellis and Maunder, and with the speed deduced by Arrhenius for these negatively electrified particles.

But a difficulty arises here, for the emission of these particles from the sun should result in its soon assuming so great an electric charge of positive sign as to hold back the negative particles. But if these drops should agglomerate the potential increases, and larger masses are formed which can part slowly with their negative charge in the form of electrons traversing space with a velocity much less than that of light. Such electrons would, in general, not pass by many suns without being caught by them. In this way, Professor Arrhenius suggests that the supply of negative electricity to the suns is proportional to their deficiency in it. This balance supposes that the chief forces driving the particles away from the sun are, like the pressure of radiation, not electric; but for the negative electrons caught by the sun, forces other than electric are relatively insignificant.

* * *

Mr. Yendell's Observations of the Colour of Certain Variable Stars.

In the *Astronomical Journal* for June 20, 1904, Mr. Paul S. Yendell gives an extension of Professor Chandler's examination of the colours of the variable stars (*A. J.*, VIII., 137) to the more recently discovered variables. The observations were made with a screen of a full blue colour, formed into a double eye-glass, so that it could be used either with the naked eye or with the binocular, and an examination of the spectrum of the light transmitted by this glass showed a large absorption throughout the whole of the red and yellow. The observations were carried on more or less continuously from 1893

until 1901, and the cases of 53 stars are discussed. These 53 stars are divided into three classes according to their types of variation. There are eight short-period stars of the η Aquilæ and β Lyræ types; seven of types which may be called intermediate with periods of from 46 to 165 days; and 38 stars which are distinctly of the long-period type. In the first class, where the stars have a short-period variability, there does not seem to be any suggestion of a relation between colour and length of period. In the second class, or "intermediate" stars, there is evident a marked progression in the lengths of their periods, corresponding to that in their observed colours. In the third class, consisting of 38 long-period stars, the correspondence between depth of colour and length of period is so marked as to point strongly to some real connection between the two, confirming Chandler's dictum that "The redder the tint, the longer the period." The variation also seems to become increasingly irregular.

* * *

The Spectroscopic Binary, β Aurigae.

Not quite a year ago, Mr. G. A. Tikhoff, from a discussion of spectrograms of β Aurigæ taken at the Pulkowa Observatory, concluded that the star is not merely double but quadruple, being composed of two groups of bodies, each of which consists of a star with strong lines and a second star with weak lines. The revolution of the two groups takes place in slightly less than four days, but of the stars in each group in one-fifth of this time. This inference was based on the complex appearance occasionally presented by the Hγ line; and caused Professor Vogel to set on foot a new series of observations of the star. These have not led him to support Mr. Tikhoff's views. By a very slight alteration of the adopted period he was able to bring the 85 observations at his disposal very satisfactorily on a single curve; and he concludes that there is no sufficient reason to accept the quadruple structure of the system. With a circular orbit and a period of 3·9599 days, and a relative velocity of 222km., the mass of the system comes out as $4{\cdot}5 \sin^{-3} i$ that of the sun, and the distance of the two bodies apart as $a \sin i = 12{,}000{,}000$ km. The radial velocity of the system is found by Vogel to be -21 ± 1 km. agreeing well with those found by Deslandres and Tikhoff.

* * *

The Visibility of Lines and Wires.

Mr. Lowell is following up his earlier experiments as to the extreme limits of visibility of lines and wires, and in Bulletin 10 of the Flagstaff Observatory, he gives the results obtained by two of his assistants. These found it possible to glimpse or suspect a line or wire when its angular width was only 0″·8 of arc. No marked difference was found between the limit for a blue line ruled on white paper, and that for a wire seen against the sky.

* * *

Radial Velocities of the Pleiades.

The Pleiades in general do not give spectra favourable for determinations of radial velocities; they lack the metallic lines seen in Sirian and solar stars, and the lines of helium are usually weak and diffuse. Mr. Walter S. Adams has been able to deal with six stars of the group with some success; the speeds deduced in kilometres per second being as follows:—Merope + 6, Atlas + 13, Electra + 14, Alcyone + 15, Taygeta + 3, whilst Maia was found to vary in velocity. Merope was observed with most difficulty, Maia with least; the first four stars showing spectra like those of nebulous stars, whilst Taygeta and Maia should possibly be regarded as not physically connected with the nebulosity.

* * *

An Expedition for Solar Research.

Professor G. E. Hale is conducting an expedition to Mount Wilson (5886 feet), near Pasadena, California, for the purpose of making special investigations of the Sun. The chief instrument will be the Snow horizontal telescope recently constructed at the Yerkes Observatory. This consists of a 30-inch cœlostat, with a 24-inch subsidiary mirror by which the light can be deflected on one of two concave mirrors also of 24 inches diameter. One of these has a focal length of 60 feet, the other of 145 feet. The latter giving a 16-inch solar image will be used in conjunction with a spectroheliograph of 7 inches aperture and 30 feet focal length. Three focal slits will be used together, so that three different parts of the spectrum may be photographed simultaneously. The 60-foot mirror is to be also used in connection with a spectroheliograph, but a special attempt will be made to photograph with it some of the brighter stars, using a stellar spectrograph provided with a large concave grating and mounted in a constant temperature laboratory.

* * *

Eclipse Problems.

In the *Popular Science Monthly* for June, 1904, Professor W. W. Campbell discusses the more important points of eclipse problems. He first considers the question of intramercurial planets. The experience of 1901 was almost but not quite conclusive against their existence; if similar successful photographs were taken in Labrador, Spain, Tunis, and Egypt in 1905 the question would be settled one way or other. The reversing layer comes next. Additional work with more powerful instruments in perfect adjustment is required; and especially photographs taken on continuously moving plates are needed, since exposures of two or four seconds integrate the changes which are going on. The chief problem is the corona, since we do not yet know whether the material of the streamers is moving outward, inward, or in both directions, or in neither. It is essential that identical instruments of long focus be employed in at least three widely separated stations to photograph the corona with a common scheme of exposures. Professor Campbell regards this question of coronal movement as the most important of the coming eclipse. Other problems are the sources of light and heat for the outer corona, calling for thermographic and polarigraphic observations; the bright-line spectrum of the inner corona in 1905, at sun-spot maximum, comparing the thickness and uniformity of this stratum with the results obtained at the recent eclipses at minimum; the accurate determination of the wave length of the truly coronal lines so that a serious effort may be made to represent them by a simple common law, as with hydrogen and helium. Professor Campbell concludes with insisting on the need for insuring against personal failures by at once making the fullest possible preparation. Failures in the past have been largely due either to attempting too large a programme for the time of totality, or more usually to want of adequate experience of the instruments or methods employed.

ORNITHOLOGICAL.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

Killdeer Plover in Aberdeenshire.

READERS of this column will probably be interested in the fact that I have just discovered an undoubtedly British-killed example of the Killdeer Plover (*Ægialitis vocifera*) in the University Museum of Aberdeen, though for thirty-seven years it has passed for the common ringed Plover (*Æ. hiaticula*). The label on this specimen runs as follows: "*Charadrius hiaticula*, Ringed Dotterel, shot at Peterhead by Andrew Murray, jun., Esq., 1867."

From this label, which is yellow with age, there can be no doubt but that this bird was presented by the donor simply as a common ringed dotterel. To allay all doubt, Professor J. Arthur Thomson, in whose care this bird now rests, has kindly interviewed Mr. Murray for me, and he distinctly recollects the circumstance in connection with this incident.

The Killdeer Plover is admitted into the British list by Mr. Howard Saunders on a single example shot at Tresco, Scilly Islands, and described in the *Zoologist* for 1885, p. 112.

* * *

Yellow-legged Herring Gull at Dover.

At the last meeting of the Ornithologists' Club, held June 15, the Hon. N. Charles Rothschild recorded that he had observed in Dover Harbour, on April 18 last, a bird which he considered to have been an example of the Yellow-legged Herring Gull (*Larus cachinnaus*). The bird in question was flying in company with

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several of the common Herring Gull (*L. argentatus*), and passed unusually close.

The bird was noticed to have orange legs, not only by his brother, the Hon. Walter Rothschild, but also by the Hon. F. R. Henley.

* * *

Longevity of Eagle Owl.

Mr. E. G. B. Meade-Waldo has just forwarded to the Natural History Museum a female Eagle Owl (*Bubo ignavus*), which had lived seventy-two years in confinement, having been brought from Norway in 1829; and during the last fifty years had reared no less than ninety young.

The mate of this bird is now fifty years old, and still vigorous.

Although the Eagle Owl is reputed to live to a great age, there are surprisingly few similar instances recorded where the age has been definitely ascertained. A golden eagle which died at Vienna in 1719 was known to have been captured 104 years previously; and a falcon, of what species is not recorded, is said to have attained an age of 162 years. A white-headed vulture taken in 1705 died in the Zoological Gardens at Vienna in 1824, thus living 118 years in captivity.

* * *

Herring Gull Laying in Confinement.

I have recently obtained circumstantial evidence of the fact that a Herring Gull (*Larus Argentatus*) has, after twenty-two years in captivity, commenced egg-laying. Two eggs were laid by this bird during the present spring, at intervals of a week. Both were quite normal in size and colour, and, after laying the second egg, the bird commenced to sit, but the eggs, of course, were infertile. Wild Herring Gulls frequently approached her, but of these, strangely enough, she took no heed.

* * *

Breeding of Crested Screamer in Confinement.

A pair of Crested Screamers (*Chauna chavaria*) have just successfully hatched out three nestlings in the Gardens of the Zoological Society. Careful observations kept during the period of incubation show that the male takes a full share of the brooding, which lasts three weeks. The young are said to resemble goslings, but not very closely. They are yellow in colour, and have *no* stripes. They are described in the *Field* for July 9 as having no down, but being clothed in feathers which are miniature copies of those of the Rhea. This description is somewhat remarkable, and demands further consideration.

* * *

Allen's Gallinule at Sea.

An example of Allen's Gallinule (*Porphyriola Alleni*) has just been sent to the London Zoological Gardens. It was taken at sea, 140 miles from the nearest land—the west coast of Africa. A similar instance occurred in 1879, when a specimen was taken on board a ship off the coast of Sierra Leone.

ZOOLOGICAL.

Armadillos in North America.

WITH the exception of one or two species, ranging into Texas and the adjacent States, armadillos, both recent and fossil, have hitherto been supposed to be confined to South and Central America, inclusive of Mexico. The discovery is, however, announced of the skeletons of extinct members of the group in the Lower Tertiary, or Eocene, formations of the United States. In place of the bony armour characteristic of the existing and later Tertiary members of the group, these primitive armadillos appear to have had their backs protected merely by a shield of hard leathery skin. The discovery must profoundly modify current views as to the origin of the South American fauna, indicating apparently that armadillos, at any rate, were immigrants into the southern half of the New World from the North.

An Insect Pest.

One of the most terrible of insect pests appears to be the minute black fly of the Mississippi Valley, commonly known as the buffalo gnat, from a fancied resemblance in outline to the buffalo, or bison. The buffalo-gnat chiefly attacks the larger kinds of live stock, although it will occasionally bite, and even kill, human beings. In the year 1874 it is stated that in a single county in Tennessee these insects killed stock to the value of £100,000; while within a single week one parish in Louisiana lost 3,200 head of live stock. Horses and mules, during such visitations, are killed while working, or before they can be got under cover when grazing; while in some of the cities on the Mississippi the running of tramcars has been rendered impossible.

* * *

Gulls and Fish.

Confirmation of the view expressed in our last issue as to the serious extent of the damage caused to our sea-fisheries by gulls is afforded by a note in the *Field* of July 11, from Mr. J. A. Harvie-Brown, a well-known field naturalist. According to this gentleman, there can be no doubt that certain species of gulls, if not indeed all, are far too numerous, not only on account of the fish they destroy, but also owing to the destruction they inflict on the eggs and young of other birds. Mr. Harvie-Brown goes, however, further than this, and considers that much of the bird protection in this country is downright harmful.

* * *

A Rare Rodent.

Everything comes to him who waits. As noticed in our summary of papers read, Dr. E. A. Goeldi has recently communicated to the Zoological Society a notice of certain rodents living in the Museum at Pará, Brazil. The species to which these rodents belong (*Dinomys branicki*) has been hitherto known only by a single specimen which was found early one morning about the year 1873 wandering in the courtyard of a house in Lima, Peru. Although it was considered by its describer to indicate a family and genus whose nearest relative is the Paca (*Cælogenys paca*), the suggestion has been made that it was a hybrid between that animal and some other large rodent. The specimens now living at Pará suffice to dispel this theory; and when Dr. Goeldi's description is published we shall be able to appreciate the true affinities of this remarkable and interesting creature.

* * *

The Orkney Vole.

Unusual interest attaches to the discovery by Mr. J. G. Millais in the Orkneys of an entirely new species of short-tailed field-mouse, or vole, which is described in the *Zoologist* for July under the name of *Microtus orcadensis*. Having no affinity with the red-backed, or bank, vole (*Evotomys glareolus*), the Orkney species comes nearer to the common field-vole (*Microtus agrestis*), from which it differs not only in proportions and colour, but likewise in the structure of its cheek-teeth. It is, therefore, nothing in the way of a sub-species, but a perfectly distinct species, which does not appear to present a near relationship with any other known member of the group. That such a totally distinct type should turn up in the Orkneys is certainly most surprising, and it suggests a number of problems in the geographical distribution of animals. Mr. Millais is to be heartily congratulated on having been the means of making known such an important and interesting addition to the British mammalian fauna.

* * *

Papers Read.

At the final meeting for the session 1903-4 of the Zoologica Society of London a large number of exhibits were made and papers taken. Among the exhibits, reference may be made to a series of hybrid pheasants killed in the coverts at Woburn Abbey belonging to the Duke of Bedford; and likewise to a skull of the Cape crowned crane, showing bony processes suggestive of the horns of mammals. Living specimens of hairless rats and mice were also shown. The papers included one by Colonel J. M. Fawcett on certain butterflies from the North-West Himalaya and elsewhere, and a second, by Mr. A. G. Butler, on seasonal changes in butterflies. Captain R. Crawshay contributed notes on the prey of the lion, directing

special attention to a number of porcupine quills found buried in the fore-paws of one of these animals. Mr. F. E. Beddard read papers on certain features in the anatomy of three groups of reptiles, namely skinks, sea-snakes, and the Australian skinks of the genus *Tiliqua*. Next came the communication by Dr. Goeldi on the South American rodent *Dinomys branicki* to which special reference is made in an earlier paragraph of these "Notes." Dr. C. Satunin described the black wild cat of Transcaucasia as a distinct species; while Mr. Lydekker contributed notes on a new race of buffalo from East Central Africa, and on a new species of tufted deer (*Elaphodus ichangensis*) from Ichang, Central China. Finally, Dr. A. S. Woodward read a paper on two skulls of primeval salamanders, or labyrinthodonts, from strata of Triassic age, the one from Staffordshire and the other from Spitzbergen. At the last meeting for the session of the Geological Society of London, Mr. W. F. Gwinnell described the vertebral column of a small plesiosaur from the Rhætic strata of Westbury-on-Severn, Shropshire. Hitherto the plesiosaurian vertebræ obtained from this horizon have consisted only of isolated vertebræ. At the final meeting for the session of the Linnean Society held on June 16, Dr. W. Kidd read a paper on variations in the arrangement of the hair on the neck of the horse, in which it was sought to test the validity of the theory that certain peculiarities in hair—arrangement among them—are generally due to mechanical causes. Mr. J. Cash contributed a paper on British freshwater rhizopods.

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The Poison of Vipers.

For some time it has been known that the serum prepared from cobra-poison and known as Calmette's antivenin is to a great extent effectual against the results of the bite of the snake itself. Experiments have recently been undertaken by Dr. Rogers, of the Indian Medical Service, with a view of ascertaining whether a similar serum has equally good effects against the results of the venom of the Indian sea-snakes and other members of the colubrine group whose bite is poisonous. The results of these experiments have been published in a recent issue of the "Philosophical Transactions," and serve to show that the poison of all these snakes has the same effect, namely, paralysis of the lungs. Accordingly, there is every probability that such poisonings may be neutralised by a serum like Calmette's antivenin, although this must be of much greater strength in order to be effective. On the other hand, it has been found by Dr. Rogers that the poison of snakes of the viperine group, such as the true viper, pit-vipers, and rattlesnakes, belongs to an altogether different category, causing paralysis of the heart. To fight this effectually it would seem necessary to prepare from vipers' venom a serum analogous to Calmette's antivenin; and until this be discovered, only empirical methods of counteracting the effects of the poison can be employed.

* * *

The Supply of Ivory.

During a recent visit to the London Docks, Her Majesty the Queen was informed that the stock of ivory then shown represented, on an average, the annual slaughter of some 20,000 African elephants. This statement has been contradicted in two letters in the daily papers. In one of these Messrs. Hale, of 10, Fenchurch Avenue, state that at least 85 per cent. of the supply is "dead ivory," mainly obtained from hoarded stores of the African native chiefs, who are shrewd enough to put their commodities on the market only in driblets. The most interesting part of the letter is, however, the statement that the great bulk of this hoarded ivory is obtained from "elephant cemeteries"—spots met with here and there in the jungle where elephants have resorted for centuries to die. Much of the ivory that comes to the market may, therefore, according to this letter, be several hundred years old. The marvel is why it is not devoured in the jungle by porcupines, as certainly happens with tusks of the Indian elephant which are left in the jungle. The letter adds that very little ivory is now obtained by hunters.

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Popular Economic Zoology.

The following is culled from the "Woman's Column" in a recent issue of a local paper: "There are two divisions of pearls, the Oriental, by far the most valuable, and the baroque The latter are embedded in shells, and have to be cut out—a process at once difficult and delicate, needing to be performed by very practised workers. The Oriental, of course, are found in fish. The pearl, although one of the most beautiful of jewels, and a particularly dainty gem, has a curious origin. It is formed by the saliva of fish, and it is supposed that a grain of sand, perhaps, or some other equally irritating foreign matter, has caused the fish discomfort, and it has covered the sore with saliva, pursuing the process continually until a pearl of considerable size becomes formed. This is proved by the fact that when a pearl is cut in half always a small speck is found in the centre." And this in an age when we have technical education and science lectures all over the country, to say nothing of special memoirs on the origin of pearls in various scientific journals!

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Striped Hawkmoth in England.

In his "British Moths," published in 1874, the late Edward Newman, in describing the species known as the striped hawkmoth (*Dilephila livornica*), stated that most of the specimens alleged to be British were really of Continental origin, but that there were a few undoubted British examples of this beautiful moth. According to the *Entomologist* for June, the present year will be notable for the number of specimens of this species taken in this country, no less than eight being recorded in that issue. The localities where these captures were made are Carlisle, Yelverton (near Plymouth), Wormwell (near Dorchester), Marsemoor (near Gloucester), Bournemouth (where another specimen had been taken earlier in the year), Brockenhurst, and the Isle of Wight (2).

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A Link between Birds and Reptiles.

It is a well known fact that in certain groups of birds—notably the petrels and albatrosses—the horny sheath of both the upper and lower half of the beak is composed of several distinct pieces. In a communication to a Swedish Zoological journal (*Arkiv för Zoologi*, vol. i., p. 479), Dr. E. Lönnberg identifies these elements with certain scales to be found on the head and lower jaw of lizards and other reptiles. If these conclusions be well founded, we have another link in the chain connecting birds with reptiles.

Botanical Notes.

By S. A. SKAN.

THE genus *Begonia*, in some of its numerous representatives, is met with nearly everywhere where plants are cultivated, and though differing very markedly in their vegetative characters, all its species are generally easily recognised by their flowers. When the order Begoniaceæ was elaborated for Bentham and Hooker's *Genera Plantarum*, the number of species of *Begonia* known was about three hundred and thirty, natives of the warmer parts of Asia, Africa, and America. One of the most recent additions to the genus is dealt with by Dr. Trelease in the *Fifteenth Annual Report of the Missouri Botanical Garden*. The new species, appropriately named by Dr. Rose *Begonia unifolia*, is remarkable in possessing only one leaf. It belongs to the tuberous-rooted group, and its scape, bearing a few, rather small, nearly white flowers, arises from the sinus of the single rounded leaf. The plant is peculiar in its habitat, for it was found growing on rocks, with its roots penetrating into crevices; and the large leaf is closely adpressed to the surface of the rock, serving an important function in protecting the lower portions of the plant. It is a very distinct species, having only one close ally, *B. monophylla*, a little known plant from New Spain.

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The United States Department of Agriculture has recently issued a useful bulletin, by Dr. G. T. Moore and Mr. K. F. Kellerman, on "A Method of Destroying or Preventing the Growth of Algæ and certain Pathogenic Bacteria in Water Supplies." The presence of Algæ in water frequently causes trouble, and many of the methods recommended for getting rid of it are impracticable, inasmuch as their adoption would spoil the water. According to the writers mentioned above, "it has been found that copper sulphate, in a dilution so great as to be colourless, tasteless, and harmless to man, is sufficiently toxic to the Algæ to destroy them or prevent their appearance. A solution of one part of the sulphate to about 50,000,000 parts of water has been found fatal to *Spirogyra*, and one part to 4,000,000 appears to be destructive to the blue-green Algæ."

* * *

In an interesting paper by Prof. D. H. Campbell in *Torreza* for June, on the "Resistance of Drought by Liverworts," which are usually considered to be moisture-loving plants, attention is drawn to the remarkable vitality exhibited by the fronds of the "gold back fern," *Gymnogramme triangularis*, which grows in the neighbourhood of Stanford University, California. In the resting season the fronds of this fern do not die down, as is commonly the case in ferns, but they dry up and persist, and to all appearance are dead. However, on placing such a frond in water its freshness and activity are quickly restored by the absorption of water through its superficial cells. The prothallia of this fern are able to survive complete drying up. Some were allowed to remain perfectly dry during the whole summer of 1903, and on receiving water in the autumn produced numerous young plants. Prof. Campbell refers to certain devices in Liverworts for preventing excessive loss of water during periods of drought. In some the growing point is protected by hairs or scales, which sometimes secrete mucilage; while the life of others is continued by the development of tubers, which, being more or less subterranean, are less influenced by a dry season.

The British Association.

IN a fortnight's time, at Cambridge, the British Association will once more engage in its annual tournament of meetings and discussions, and the swing of the scientific and social pendulum will proceed for a week as smoothly and hospitably as loyal endeavour can ensure. That the Right Hon. A. J. Balfour will deliver an address as the in-coming president, is a circumstance which must naturally lend distinction and *éclat* to the congress.

So long is it since the Association met at Cambridge, that it is permissible to indulge in a brief retrospect in order to call up from the past some of the doings of the former gathering. The last occasion of meeting in the university town was in the year 1862, under the presidency of the Rev. Prof. Willis, F.R.S., Jacksonian Professor of Natural and Experimental Philosophy. The Association was then holding its thirty-second meeting, while it now inaugurates its seventy-fourth. Among the presidents of sections was Prof. G. Gabriel Stokes, who filled the office for Mathematics and Physics, and it was at this meeting that the late Master of Pembroke presented his valuable report on Double Refraction. Mr. Francis Galton—happily still among us—was president of the section appertaining to Geography and Ethnology. Huxley, too, was there, presiding over the proceedings of Section D. Tyndall discoursed on the Forms and Action of Water. Sir Rutherford Alcock, in Section E, read a communication on the civilisation of Japan, of which it is interesting to note that his pregnant sentences stand forth to-day in honour of Japanese progress. The race might tell us with truth, he said, that for centuries they had had under their own laws, customs, and institutions, a degree of peace, prosperity, and freedom from foreign wars which no country in Europe had enjoyed during any century of its existence. They were possessed of so many excellent qualities and such an aptitude for a higher civilisation than they had yet attained, that within a very few years not only might we see them make a great and unexampled advance, but reach a trade development to which it was really difficult to fix any limit. Sir Roderick Murchison read a letter from Livingstone, dated Shupanga, River Zambesi, informing him in pathetic terms of the death of his wife, and the darkened horizon it occasioned. The attendance at the congress reached a total of 1,161.

As regards the forthcoming assembly, it is reasonable to expect that the special attractions of Cambridge, coupled with the presence of a Prime Minister, will raise the inconveniently low average of attendance which has prevailed during the past three years of the Association's meetings. Such a result was seen at its Oxford gathering in 1894, when the Marquis of Salisbury was President. Nevertheless, the British Association cannot afford to rely upon quadrennial fortune, and its friends are concerned not only to secure the adhesion of a greater number of annual members and other steady supporters, in consonance with the activities of modern science, but to improve the attendance at the congresses of the general public. There has been a steady decline in numbers in recent years. At Glasgow, in 1901, the attendance was 1,912, and the receipts £2,046; at Belfast, in 1902, they were, respectively, 1,620, and £1,644; at Southport, last year, 1,754 and £1,700, the former nearly 1,000 less than at the Southport meeting in 1883. As a matter of course, grants for scientific purposes decrease with lessened prosperity while other avenues of usefulness remain unopened. Good attendances prophesy revenue, and a satisfactory balance-sheet connotes ability to make allotments for such investigations as are deserving of recognition and help. Congressional bodies, in fact, cannot nowadays despise the legitimately commercial side of their gatherings, and the British Association in this respect should "wake up."

Certainly no one would wish to extend carping criticism to an organisation which has done yeoman's service in the interests of science and of national enlightenment. Apart, however, from the foregoing considerations, there would appear to be channels for improvement. Take, for instance, the sectional addresses. Some of these have latterly become inordinately long, and suggest limitation. Curtailment in the addresses of a President of the Association would not be good policy, nor is it required. The man of science elected to that honourable office has something to say, and should have space for his utterance. But those who fill the chairs of the sectional committees might surely give pause, and compress. The tendency is towards enlargement, and accompanying aggrandisement of type; this weighs heavily on many

men, who unwillingly rifle their brains and imagination for words, words, words. The presidential address of 1902 occupied 48 pages of the familiar brick-coloured volume. In the committees, certain presidential discourses extended to 25, 19 (two cases), and 18 pages of closely printed matter. True, there were compensations evident in a modest venture of 9 pages in one instance, and of 8 pages in another.

The one-year rule applicable to the occupancy of the presidential chair is a golden fetter around the neck of the Association. In all likelihood the distinguished men who are at present compelled to retire annually would be willing—nay, proud—to serve for a longer term, at any rate for a biennial period. Under such conditions they might reasonably hope to be of real service to the Association each in turn and according to his opportunities, with corresponding benefit to the whole organisation.

The Report of the Association, containing addresses and papers read in the sections, we take leave to say, should be in the hands of members earlier in the year. At the moment of writing, the volume for the Southport meeting, held in 1903, has not yet appeared. Perhaps it will be laid on the table at Cambridge.

Finally, may we not with advantage quote the objects of the British Association? They are:—To give a stronger impulse and a more systematic direction to scientific inquiry; to promote the intercourse of those who cultivate science in different parts of the British Empire; to obtain a more general attention to the objects of science, and a removal of any disadvantages of a public kind which impede its progress.

[A British Association Supplement of "KNOWLEDGE & SCIENTIFIC NEWS" will be published during August.—EDITOR.]

REVIEWS OF BOOKS.

New Land.—One might well call Otto Sverdrup's history of his four years' work on the north coast of Greenland ("New Land: Four Years in the Arctic Regions," by Otto Sverdrup, translated from the Norwegian by Ethel Harriet Hearn; 2 vols.; London: Longmans, Green, and Co.; price 36s. net) an Arctic Odyssey. There is something in this book which has the space and largeness of purpose of an epic. It is a large book. It is full of detail. But through it all runs a singleness of purpose and a sense of vividness which removes it far from an impression of travel, a record of exploration, a summary of achievement, and places it before one as a human document. The story of four years of the life of brave and earnest men who were hemmed in by the harshest of Nature's conditions—in journeyings often, in sickness often, in hunger and thirst often, in perils often. It is on this aspect of the volume that we would soonest enlarge. Their scientific value as an addition to the knowledge of the Polar seas and land is admitted and established; and they occupy a place by right on the bookshelves of the geographer, the naturalist, the geologist, and the meteorologist. But, as Lord Kelvin said when some years ago the question of an Antarctic expedition was first mooted, the best ground on which to appeal for help for such work is the ground of "exploration." That word has a magic for people to whom scientific results are of little import; and "exploration" of that fascinating kind in which the explorers seem real people of like passions and weaknesses with ourselves is to be found at its best in Captain Otto Sverdrup's tale. Its introduction is characteristic. Says Captain Sverdrup: "A few days after our return from the first Norwegian Polar Expedition, we were lying in Lysaker Bay unloading the *Fram*, when Dr. Nansen came on board. 'Do you still wish to go on another expedition to the North?' he asked me. 'Yes, certainly,' I answered, 'if only I had the chance.' He then told me that Consul Axel Heiberg and the firm of brewers Messrs. Ringues Brothers were willing to equip a new scientific expedition with him as leader. The Norwegian Government gave the *Fram*, and added £1100 to the cost of the enterprise. As an exploratory expedition, the main object aimed at was the investigation of the North Coast of Greenland by way of South Sound and Robeson Channel, and the determination of the island character of Greenland. The captain was to have a free hand, and there was no question of reaching the Pole. They were to go for two or three years; but after passing their third winter at the head of Goose Fjord, they looked forward to release; in the summer they still found themselves ice-bound. In the summer of 1901 they advanced a distance of only nine miles, and five miles of an impenetrable barrier still stretched between them and the freedom of the open sea. It was not till August, 1902, that the *Fram*, having broken the bonds of her long imprisonment, reached Norway, and received the welcome that the Norwegians and the whole world was ready to give them. The expedition had been a great success, and geographically it had added greatly to our knowledge of the Peary Archipelago; had established an outlet from Hayes Bay; had delimited to the west Ellesmere Land, Grinnell Land, Grant Land; and had brought back many valuable geological, botanical, zoological, and meteorological data—all of which are tabulated and summarised in the capitally translated and beautifully illustrated volumes that Messrs. Longmans have published.

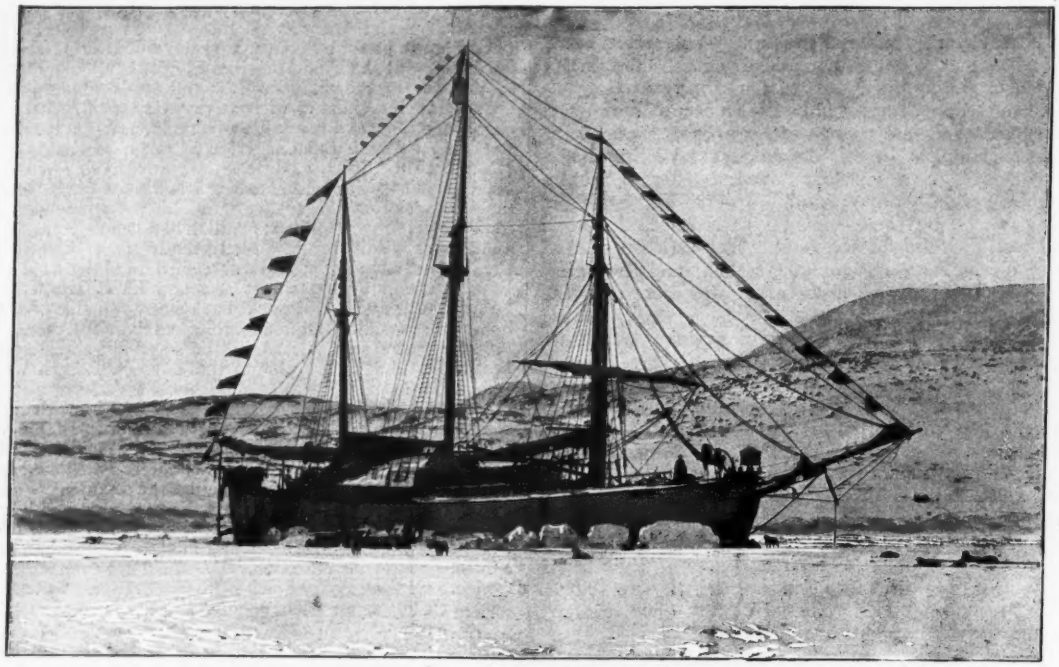
But, as we have said, the charm of this work for the general reader lies in the manner of Captain Sverdrup's telling. He has the sailor's gift of telling a good yarn. Quite early in the frozen solitudes of the north he encountered a fellow explorer—a meeting of which we realise alike the strangeness and unexpectedness. It was Lieut. Peary, whose ship had been ice-bound off Cape Hawkes. But he only stopped a few minutes—for all the world as if they had met on a suburban station platform with trains to catch. He would not even stay to take coffee. "I took Peary down to the sledge, and watched him disappearing at an even pace, driven by his Eskimo driver. . . . . We talked of nothing else, and rejoiced at having shaken hands with the explorer, even though his visit had been so short that we had hardly had time to pull off our mittens." The incident is briefly told, but it is wonderfully vivid; as vivid as that unconscious word-picture that Sverdrup draws of his vessel in its ring of ice and silence: "There lay the *Fram* stout and defiant like a little fairy house in the midst of the Polar night." It is in this little fairy house that the four years homely epic of travel takes place. It is here the Doctor dies, and is buried with tears and prayer. It is here that they have their merrymakings; their procession with banners on Constitution Days (May 17th); their newspaper, "*The Friendly One*," and their Christmas festivities. Do you wish to learn how gay and natural a touch there is in this book; you will find it it in the pages that tell of Christmas Day. "When the Christmas tree was brought in, everybody was quite silent for a moment—and then the merriment broke loose in earnest. As it stood there, with its glittering gold and silver tinsel, and its red and white candles, in the midst of our darkness here, it seemed to be a greeting from home and from above. It seemed as if we were being told that there was still life, and that the light was not really gone. We thought that we were sitting amid our dear ones, could take them by the hand, could feel that they really lived; it was as if happy thoughts had been sent to us—and thus we had to shout for joy and make a horrible noise, much worse than our four-footed friends outside in the snow. And what was a sob within us found expression in a terrible hubbub, especially when all the Christmas presents were undone. They were chiefly children's toys—for men who felt like children! Drums, trumpets, fireworks, dolls, Noah's arks, sneezing powder, scratching powder, marzipan pigs, and things of that kind. There was merriment beyond compare, and practical jokes without end."

It was not all simple gaiety among the travellers. The death of the doctor, followed by another death, plunged them presently into depression, a depression deepened by their comparative ignorance of medicine and the obsession for the "oncoming Polar night." But when one of the crew dislocates his shoulder, the accident, though serious, maintains in Sverdrup's pages a cheerful view. There is a good deal of humour in it.

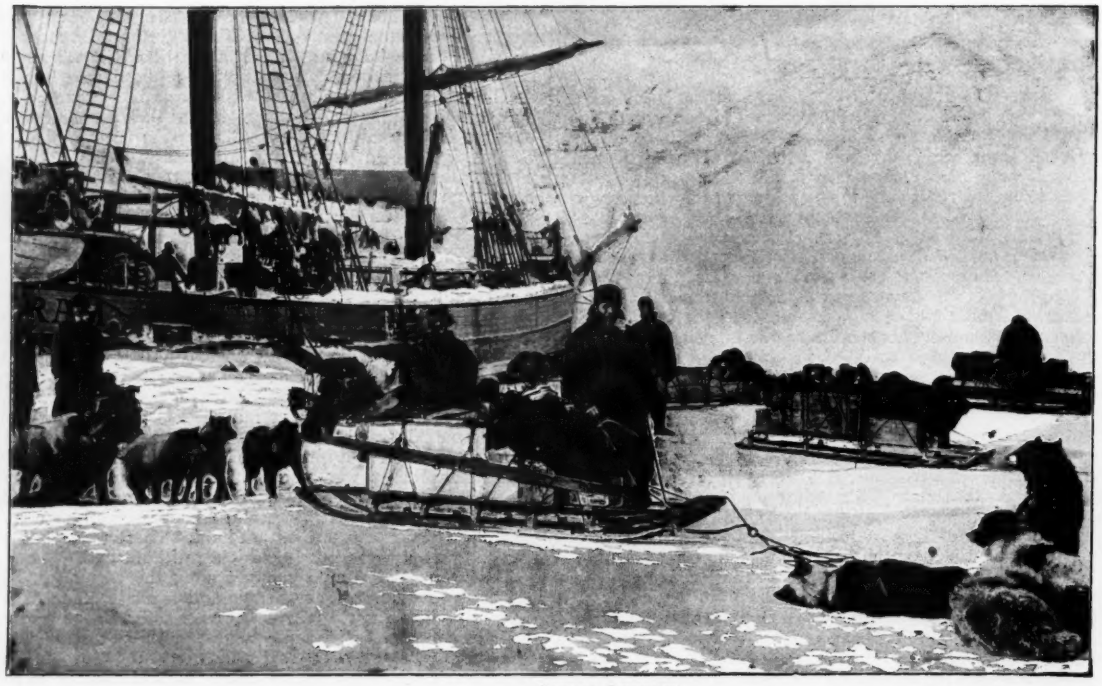
"What had we better do for Olsen's arm? We found some diagrams and various directions as to how a dislocation should be reduced, and after some consideration, chose the way which seemed the easiest and most simple. The opera-

tion would have been easy enough had we dared to chloroform our patient, but we had no desire to attempt such a thing. Several days had elapsed and the arm was swollen and angry.

for *that* we could better grapple with. For this purpose we first tried naphtha, but that did not do; he disliked the taste of it so much that I could not bring myself to force it on him.



The Fram in Winter Quarters.



CAPTAIN SVERDRUP.

Start for the Journey.—Spring, 1901.

Inexperienced as we were we should probably torture poor Olsen most horribly before we got his arm into place again. I therefore decided to make him thoroughly drunk—the effects

We had things that tasted considerably better. I sent for a bottle of the very best cognac, and began to give him dram after dram. But it really was too much to expect him to drink

himself half seas over in dry nips all alone, without any other diversion, so I sat down and talked to him about everything I could think of. At first he was very much taken up with his arm, but from that we went on to the expedition in general, then to shooting in general, and lastly, after innumerable excursions landed, in the Loffoden Islands in which he was patriotically interested. In this way I brought him little by little into brilliant spirits. He grew livelier at every dram. Fosheim and Simmons, who had been chosen for the deed of bone-setting, sat awaiting the propitious moment, following with much excitement his various stages of development during our potations, while I talked myself blue in the face to get him to drink more and hark on the crisis. It was not long before Olsen himself began to be highly pleased at the whole performance, declaring it was the most amusing entertainment he had ever taken part in. When he had swallowed about half a bottle of brandy we thought he must be about ripe to be taken. We accordingly placed him on a chest, and the bone-setters began their work, but no, the collar would not go in . . . . . at last, however, we heard with unspeakable relief the crack of the arm as it slipped into its socket. As for Olsen, notwithstanding all he had taken down, it had not much effect on him. While we were doing our work, the pain and excitement had kept him sober, but the instant the arm was in its socket he became dead drunk." The operation in the result proved quite successful. We have not space for further extracts from this deeply interesting book. We may say of it in conclusion that its interest and value arises from its essentially human aspect. Even the dogs become the reader's as well as the writer's friends; and Sverdrup gives us some quite new views about the Eskimo. In short, he is a shrewd observer, a kindly critic, a good writer, and a man to the backbone. His book is worthy of him.

Zoological Notes for instruction in schools, of a kind which is likely to attract as well as to instruct children, are being published by Messrs. Asher and Co., of Covent Garden. The plates, large in size and printed in colour, are German in origin and manufacture (Schroder and Kull's Biological diagrams); and if, on the one hand, they are wanting in artistic feeling, the amount of information they convey of the characteristic surroundings, occupations, attitudes, anatomy and allied species of the animals pourtrayed is surprising. It is probable that such plates leave a stronger impression on a childish mind than others more artistic or more photographic.

"**Our Country's Animals**" (Simpkin, Marshall, Hamilton, Kent and Co.), by W. J. Gordon, is one of a very useful popular series of Natural History. Each volume is illustrated with coloured plates, so that the amateur observer of Nature in country rambles may be able to identify the stoat that runs across his path, the field-mouse that rustles away into the hedgerow as he passes, or the water-rat that his coming startles into diving from the bank into the stream. He may learn, besides, something of their species, habits, and characteristics.

"**The Nature Library**" (Fisher Unwin). "Quiet Hours with Nature," by Mrs. Brightwen, is in part republished from the "Girl's Own Paper." The author's loving observations of bird and insect life are prettily and sympathetically recorded; and her book is as pleasant to read as it must have been to write.

"**Nature's Story of the Year**," by Charles A. Witchell, of the same series, also records his observations of Nature, though in a less sympathetic spirit. No true lover of Nature could shoot a bullfinch in cold blood because it attacked his fruit trees. His book nevertheless contains much that is interesting.

"**A Modern Zoroastrian**" (Watts and Co.), by Samuel Laing, deals with scientific and moral questions, and proceeds from the study of ether and energy to consideration of religions and philosophies. It is addressed to the general reader.

"**Ethics of the Great Religions**" (Watts and Co.), by Charles T. Gorham, is a useful survey of the principal religions of the world, and the features they have in common.

"**The Ethics of the Dust**" (George Allen, pocket edition). In this little book, which was written in the form of graceful and fanciful conversations with children, Ruskin attempted to explain some of the principles of mineralogy and to awaken an interest in the study of the subject.

"**The Lion Hunter**" (John Murray), by Hon. Aleyn Gordon Cumming, which appears in a new edition, is the record of five years' adventures in the interior of South Africa, covering a period which began as long ago as October, 1843, so that the writer traversed much of what was then unknown country.

BOOKS RECEIVED.

Geography.—We have received for review the ninetieth edition of Dr. James Cornwell's "School Geography" (Simpkin, Marshall, Hamilton, Kent, and Co.). This comprehensive and clearly-arranged text-book should be useful to teachers. Its facts are judiciously selected, and the information given about each country is divided under the heads of physical and political geography so that the teacher's work is simplified as far as possible.

Geography for Beginners (Simpkin, Marshall, Hamilton, Kent, and Co.), by the same author, contains the principal facts in a simplified form.

Photography.—Practical Enlarging (Iliffe and Sons), by John A. Hodges, appears in a sixth edition. It is intended for the use of hand camera workers, or those who make use of any small cameras. Bromide enlarging, as the most popular method, is very fully dealt with, and full directions are also given for the more elaborate methods of making enlarged negatives.

Practical Slide Making (Iliffe and Co.), by G. T. Harris, F.R.P.S., is intended to supply trustworthy information concerning all the best known methods of making lantern slide transparencies; it is clearly written, and well adapted for practical purposes, with good print and a strong binding.

Photography.—Mr. W. Jerome Harrison's "Photography for All" (Iliffe and Sons) suffers from the defects of its qualities. It is designed for the instruction of those—among others—who handle a camera for the first time; and it is sometimes too elementary. This would not be a great defect if it were up to date; but that it is not, and the ways it recommends of doing things are not always the best ways.

The Photographic Dealer's Annual (Marshall, Brookes and Chalkley) is what it aims at being—largely a trade publication. But its articles are well written and to the point; and it is an extremely useful "who's who" and "what's what" to the practical photographer.

Engineering.—The Model Engineer Series (Percival Marshall and Co.) is a series of cheaply printed and fully illustrated popular handbooks; price, 6d. each.

The Locomotive is a simply-written introduction to the study of locomotive engines, distinguishing between their different types and explaining them.

X-Rays, by R. P. Howgrave-Graham, A.I.E.E., aims at giving the student some idea of the course of experiment and discovery which led to the present state of scientific knowledge of Röntgen rays.

Static Electricity, by Percival G. Bull, M.A., Oxon., describes simple experiments illustrating electrical laws and phenomena, and deals with the various means of producing electricity; and with electrical attraction and repulsion. It is designed for the use of young students, and is very clearly and simply written.

Patents Simply Explained gives directions for the patenting of inventions and the registration of trade marks and designs.

Mechanical Drawing, by F. E. Powell, is designed as a guide to the apprentice or student, and describes the use of drawing instruments, and the "reading" of drawings; it also gives directions for preparing practical illustrative sketches.

Acetylene Gas, by Cyril N. Turner, is a practical handbook on the uses and generation of acetylene gas; and is designed to enable amateur mechanics to produce it in an inexpensive way.

WE have received from Messrs. Adam Hilger, Ltd., their new list of spectroscopes and spectroscopic accessories. The list is well and conveniently arranged and the information it affords concerning spectroscopic instruments alike for general and for special work is of practical service to the investigator. The most interesting pages are those which reproduce film replicas of Rowlandson's diffraction gratings, which are ruled with 14,438 lines to the inch—a marvel of scientific handicraft; and of the Michelson echelon diffraction gratings.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, F.R.M.S.

Gelatin Plates as Light Filters.

A recent number of the "Journal of the Royal Microscopical Society" gives an abstract of a method described by a German writer for making gelatin plates which may serve as substitutes for glass light-filters for microscopical and photomicrographical purposes. A solution of the best gelatin, such as is used for making dry plates, is made in the usual way, the proportion to the water being as 1 to 200. To the filtered solution 3 cubic centimetres of 1 to 50 aqueous solution of alum are added. The films are made by pouring the gelatin on a glass plate placed on a levelling stand. When quite dry the gelatin is overlaid with a film of collodion stained with some aniline dye. Red plates may be made as follows: Dissolve (1) 2 grm. aurantia in 40 c.cm. of absolute alcohol, (2) 5 grm. rose Bengal in 20 c.cm. methyl alcohol. Then mix 20 c.cm. of (1) with 10 c.cm. of (2), and add 90 c.cm. of 4 per cent. collodion. Yellow plates can be made by adding 20 c.cm. of a saturated alcoholic solution of aurantia to 80 c.cm. 4 per cent. collodion. The gelatin plates may be doubled so as to strengthen the film, or one may be placed on either side of the coloured layer. The advantage of using coloured screens when endeavouring to photograph objects stained in such a way as to give little contrast on a photographic plate is obvious to all, and expert photomicrographers depend largely upon such means of differentiating. In an early number of this magazine I hope to give a brief and elementary account of the ordinary procedure in photomicrography, mainly for those who are photographers and who wish to utilise their knowledge in order to photograph microscopic sections, but find their results unsatisfactory, through want of knowledge of a few elementary rules of procedure.

Dry and Immersion Objectives.

Several inquiries have been sent to me as to the relative advantages of dry and immersion objectives, and though the subject is adequately treated in the various microscopical text-books, a few words upon the matter may be of service. Let us assume that an extraordinarily wide-angled dry lens can embrace an angle of 170° from an object placed uncovered on the slide, though, of course, so large an angle as this is really barely possible. Then a cover-glass placed over the objective will produce a certain amount of refraction, according to the well-known law that rays of light from a medium (in this case glass) entering another less dense (in this case air) are refracted away from the perpendicular. By this refraction a large portion of the extreme rays, which ought to enter the objective, will be refracted, some being even totally reflected, and so fail to enter it. If a denser medium were to take the place of the air, this refraction would be minimised, and if it were as dense as the cover-glass, it would be practically non-existent. This resolves into the fact that an oil-immersion objective of 82°, a water-immersion of 97°, and a dry lens of 170°, all admit approximately the same amount of light. Therefore a water-immersion, and still more an oil-immersion can be made to admit light of an angle much greater than the widest angled dry lens. There is therefore a great gain of light, and with the increase of aperture there is a corresponding gain of resolving power. There is yet a further gain of working distance. There is still a further gain, sometimes overlooked, due to the fact that the intensity of the rays are less as they become more oblique, but that they increase in intensity according to the density of the medium, in a ratio, in fact, that is measured by the squares of their refractive indices. Enough has been said to show the advantage of the immersion system of objectives. It follows naturally that the term angular aperture no longer expresses the value of an objective, and thus a new system of rating has sprung into existence, due to Professor Abbe, which takes into consideration the refractive index of the medium, whether air, water, or oil, as well as the angular aperture. The formula is $n \sin u$, where n is the index of refraction of the medium in front of the objective, and u the sine of half the diameter of the emergent pencil of light at the back of the objective. This is the "Numerical Aperture," or N.A. Finally, there is yet another advantage. Any variation in the thickness of the cover-glass in a dry lens upsets the corrections of the objective, and must be corrected by a collar which adjusts the position of the individual lenses which make up the objective, or by an adjustment of tube length. Water has a refractive index nearer to the cover-glass than air, and therefore the necessary corrections are much less serious; but cedar oil has almost exactly the same refractive index as crown glass, and so there are practically no corrections required. Of course, immersion-lenses are always high powers, and equally, of course, it is not quite as convenient, and is now and again impracticable, to use such lenses. It is scarcely necessary to add that a dry lens cannot be used as an immersion lens, nor an immersion lens in any other medium than that for which it is constructed. Immersion condensers are made in order to reduce aberrations, and to enable a cone of light to be passed which is proportional to the wide apertures of immersion objectives, and with an oil immersion condenser, an oil immersion objective, and an object mounted in Canada Balsam, we have a condenser, a connecting medium, a slide, a mounting medium, a cover-glass, again a connecting medium, and finally an objective, which are, to all intents and purposes, one homogeneous whole.

Watson's "Facility" Object-Changer.

Messrs. W. Watson and Sons have sent for inspection a new object-changer of novel construction. It is square in shape and screws on to the end of the draw-tube in the ordinary way. On the under side are a pair of opposite jaws, a quarter of an inch wide, which open by means of the handle shown in the illustration, and when released engage the threads of the objective screw and carry it up to the shoulder where it

is firmly and squarely held in place. It is made of Magnalium and so is very light; it is only half an inch thick, and it provides a rapid and easy method of changing objectives. Most workers have found that they possess one or more objectives whose screws are not cut strictly to the proper gauge, and to obviate this Messrs. Watson provide rings of absolute gauge to fit such objectives, and ensure accurate gripping in the jaws of the object-changer. These rings do not interfere with the fit of the objective in its box.

Royal Microscopical Society.

June 15th.—Dr. Dukinfield H. Scott, F.R.S., President, in the chair. Mr. T. H. Powell exhibited *Pleurosigma angulatum* under a $\frac{1}{10}$-inch, 1·35 N.A. apochromatic homogeneous immersion objective made by him. Professor Hartog exhibited a slide prepared and lent to him by Professor Vejdovsky showing the first segmentation spindle and centrospheres in the embryo of Rhynchelmis. This was so large as to be visible with a pocket lens and was distinctly shown under a $\frac{1}{4}$-inch objective and "B" ocular. Mr. Beck exhibited a portable microscope designed by Mr. Arthur Hollick. It was daily used for the examination of botanical subjects, but was equally useful for other purposes. The mirror was so mounted that it could be used above the stage for illuminating opaque objects, swinging on a centre that was at the level of the object. An ingeniously contrived rotating cell, made of cardboard, forming a convenient revolving object holder, and a simple method of

mounting in pill-boxes were described. Another point of interest was the coming down of the objective to such size as to admit as much, and no more, light than could be utilized by the back lens; this reduction of the front of the objective facilitated the illumination of opaque objects. Professor J. D. Everett read his paper, entitled "A direct proof of Abbe's theorem on the microscopic resolution of gratings." In the subsequent discussion Mr. J. W. Gordon, Mr. Conrad Beck, and Mr. Rheinberg took part. Mr. Beck explained Abbe's experiment with a grating on the stage showing doubling of the lines by means of a triple slit in the focal plane of the object glass. This he had brought at Professor Everett's request in illustration of the paper. Mr. Rheinberg followed with some remarks on the influence on image gratings of phase difference among their spectra, which he illustrated by an arrangement he had prepared of a microscope that showed the movement of lines in the image of a grating by creating a phase difference amongst the spectra in the back focal plane of the objective by means of an Abbe glass-wedge compensator. Mr. F. W. Millett's paper, the 16th of the series, on the recent Foraminifera of the Malay Archipelago was taken as read. Mr. F. Enock then gave his lecture on "Nature's Protection of Insect Life," which was illustrated by a fine series of lantern slides of colour-photographs of living insects. The following were elected Honorary Fellows of the Society: Gaston Bonner, Jacques Brun, Yves Delage, S. Ramon y Cajal, B. Renault, J. J. Harris Teall, Sylvanus R. Thompson, and M. Treub.

Quekett Microscopical Club.

The 415th ordinary meeting of the Club was held on June 17, at 20, Hanover Square, W., the President, Dr. E. J. Spitta, V.P.R.A.S., in the chair. An unusually large number of new members were balloted for. Mr. C. D. Soar, F.R.M.S., read a paper descriptive of two new Fresh-water Mites, *Pseudofeltria scourfieldi*, discovered in Cwmm Glas, North Wales, by himself, and *Mideopsis crassipes*, found at Oban by Mr. Taverner. The President then gave an interesting lecture and demonstration "On a Method of Suiting Screens for the Photomicrography of Stained Bacteria." He was assisted by his son, Dr. Harold Spitta, who exhibited a number of lantern slides and diagrams illustrative of the method and its results, and by Mr. Conrady, who manipulated a second lantern fitted with a large spectroscope, by means of which a series of beautiful and interesting spectra were thrown upon a separate screen. After comparing and contrasting the differences between the eye and the photographic plate in the matter of colour sensation, Dr. E. J. Spitta went into a comparison of the various orthochromatic plates upon the market. By testing each plate under long and short exposures with a spectroscope, he found a wide difference in their relative sensibility to colour, a difference which he illustrated by means of photographs of the spectrum taken on each kind of plate. Having ascertained by this means the limit of their sensitiveness in the presence of colour, which he termed the "eye" of the plate, he was enabled to construct contrasting screens by means of which the maximum contrast was obtainable. Photographs of bacteria stained with Löffler's blue, gentian violet, and carbol fuchsin, the three principal bacteriological stains, were exhibited, taken with and without the contrasting screens. The results were most striking, the improvement in detail and definition being very marked.

H. W. Harvey, Norfolk.

I would suggest your getting M. C. Cooke's "Microscopic Fungi," which forms a good introduction to the study of the subject.

T. H. Astbury, Wallingford.

In answer to your query as to Mr. Warburton's article on "Mites," Mr. Warburton says he uses concentrated carbolic acid for clearing. I am aware that this sometimes leads to difficulties in subsequent mounting in Canada balsam, but Mr. Warburton says he has no difficulty with it. With regard to the parasitic growths upon *Parnus prolifericornis*, if you will send me the beetle I will see what I can do with it.

Miss B. B. Bryant, Bath.

By the blow-fly *Calliphora vomitoria* is understood. It has a yellow, golden, or white head, brown eyes, black thorax, and blue abdomen with black stripes and long black hairs. The flesh-fly is *Sarcophaga carnaria*. It has a head yellow in front, with feathery antennæ, reddish eyes, grey thorax, with longitudinal black lines, black abdomen with four square white spots on each segment, and black hairs on all the body. Dr. Sharp has kindly given me the following particulars: "By blow-flies and meat-flies I think people mean the same thing, viz., the blue *Calliphora s.* But the flesh-fly is a very different insect—a grey-striped and black insect with red eyes—*Sarcophaga carnaria*. There is rather a difficulty as regards *Sarcophaga*, because there are different species; though horribly awake they apparently differ greatly in economics, the *S. carnaria* being viviparous. As regards the blow-flies, both *Calliphora vomitoria* and *C. erythrocephala* are equally common here; one has a yellow face with black beard on it, the other a black face with yellow hairs. No doubt with most people they pass as all *C. erythrocephala*. *Sarcophaga* has the abdomen *mottled* a sort of square pattern, it has very large pulvilli on the feet, is a quite different shape from *Calliphora*, and keeps in the country on the look out for carcases. There is still a great deal of much interest to be discovered about these common flies, which, though disgusting to most people, are physiologically at the top of the animal kingdom." "A List of British Diptera," by G. H. Verrall (2nd edition) may be procured from the author, Sussex Lodge, Newmarket. With regard to mounting flies whole, I would suggest your trying a weaker solution of potassium hydrate and longer immersion. The object of this soaking is mainly to dissolve out the contents of the abdomen, &c., after which the object is washed first thoroughly in water and then dehydrated in alcohol, and finally soaked (for a few days, if necessary) in turpentine to make it transparent, then cleared in clove-oil and mounted in Canada balsam. If this does not prove satisfactory, I would suggest treating the wings separately and mounting on the same slide, or mounting another fly dry for comparison.

A. Morley Jones, Ealing.

Your query has not reached me before, but you do not say what are the Zoophytes to which you refer. Generally speaking, the method of mounting would be narcotisation by cocaine by gradually adding a one per cent. solution to a small quantity of water containing the specimens, or killing at once by a drop of osmic acid, washing in water, staining if requisite, again washing, and finally mounting in glycerine jelly.

George Phelps, Warminster.

I am afraid the only reference I can give you on the subject of Trombidiid mites is to the article on Mites in "Carpenter." Mr. Michael's monographs in the Ray Society's publications deal only with the *Oribatidæ* and cheese-mites. The forthcoming volume of the Cambridge Natural History will have a short account of the *Trombidiidæ*, and I understand from Mr. Soar that a number of "Das Tierreich" shortly to be published will contain a full list and description of every species. As I have said to another correspondent, the literature with regard to mites is in a very incomplete state.

A. Robinson, Portsmouth.

An objective corrected for a short tube does not perform as well with the long tube; but it is so much a matter for a critical eye and critical illumination that I fear I cannot advise you how to ascertain the length of tube for which your objectives are corrected if your own work has not shown it to you. I would suggest, however, your obtaining a slide of the proboscis of a blow-fly, and, using the edge of the lamp-flame, carefully focus first the objective upon the slide, and then the lamp-flame by means of the condenser, so that with a moderately low power a distinctly marked band of light lies across the field. The fine hairs on the tip of the proboscis (not the long ones on the edge) are those to be looked at, and the iris diaphragm must be shut down just enough to cut off any excess of light, and not enough to cause any thickening of the filament-like points of the hairs, or any refraction rings around them. Then use the highest-powered eyepiece you have, and note whether the objective performs best when the tube is fully closed or fully extended. As a matter of fact, nearly all students' series of objectives, whether of English or Continental make, if comparatively recently made, are corrected now for the short tube.

[*Communications and enquiries on Microscopical matters are invited, and should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge.*]

XUM

The Face of the Sky for August.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 4.24, and sets at 7.47; on the 31st he rises at 5.12, and sets at 6.48.

Sunspots, faculæ, and prominences have been fairly conspicuous of late.

The positions of spots with respect to the equator and poles may be derived by employing the following table :—

Date.	Axis inclined from N. point.	Centre of disc, N of Sun's equator.
Aug. 1 ..	11° 0′ E.	5° 55′
,, 11 ..	14° 47′	6° 32′
,, 21 ..	18° 9′	6° 58′
,, 31 ..	21° 2′ E.	7° 12′

THE MOON :—

Date.	Phases.	H. M.
Aug. 4 ..	☾ Last Quarter	2 3 p.m.
,, 11 ..	● New Moon	0 58 p.m.
,, 18 ..	☽ First Quarter	4 27 a.m.
,, 26 ..	○ Full Moon	1 2 a.m.
Aug. 12 ..	Perigee (222,800 miles)	9 18 a.m.
,, 27 ..	Apogee (252,500 ,,)	4 12 a.m.

THE PLANETS.—Mercury is an evening star, setting about 8.40 p.m. on the 1st. He is in aphelion on the 17th and at greatest elongation on the 20th, hence the proximity of the time of aphelion to that of greatest elongation makes the angular distance from the sun large, and amount to 27° 24′ E ; the position of the ecliptic in the evening sky at this time of the year, however, counteracts the otherwise favourable coincidence of greatest elongation and aphelion.

Venus is an evening star in Leo, setting about 7.50 p.m. on the 15th.

Mars is a morning star in Cancer, rising about two hours in advance of the Sun.

Jupiter rises about 10.15 p.m. on the 1st, and about 8.30 p.m. on the 31st. Towards the end of the month he will be the most conspicuous object in the sky about 10 p.m., looking east.

He is at the stationary point on the 20th, after which his motion is retrograde or westerly.

The equatorial diameter of the planet on the 17th is 44″·8, whilst the polar diameter is 2″·9 less.

Saturn is now well placed for observation, being a very conspicuous object in the S.E. at 10 p.m., not very high up. The planet is in opposition to the Sun on the 10th, hence this is the most favourable time for making observations of the white spots which were seen last year and used for the determination of the period of rotation, giving a value of 10 h. 38 min.

The polar diameter of the ball is 17″·4, whilst the major and minor axes of the outer ring are 43″·4 and 11″·4 respectively. The northern surface of the ring is presented to us at an angle of 15° to our line of vision.

Uranus is on the meridian about 8 p.m. near the middle of the month, when he is about 10 minutes west of the star 4 Sagittarii. His path on the borders of Ophiuchus and Sagittarius may be seen on reference to the chart appearing in the June number.

Neptune is not suitably placed for observation, rising about 5 a.m.

METEORS :—

Date.	Radiant.		——
	α	δ	
Aug. 10-12	45°	+57°	Great *Perseid* shower; radiant moving E.N.E. about 1° per day.
Aug. 21-25	291°	+60°	o Draconids ; bright slow meteors.

THE STARS :—

About 9 p.m. at the beginning of the month the constellations to be noticed are :—

ZENITH . Lyra (*Vega*), Hercules, Draco.
SOUTH . Sagittarius, Scorpio, Ophiuchus, Aquila; Aquarius and Capricornus to the S.E.
WEST . Boötes, Corona; Great Bear to the N.W., Virgo and Libra, S.W.
EAST . Cygnus, Delphinus, Pegasus, Aries; Andromeda and Cassiopeia to the N.E.
NORTH . Ursa Minor, Auriga (*Capella* on horizon).

Minima of Algol occur on the 14th at 11.22 p.m. and on the 17th at 8.10 p.m.

TELESCOPIC OBJECTS :—

Double Stars :—Polaris, mags. 2·1, 9·5; separation 18″·6. The visibility of the small star is used as a test for a good 2-inch object glass.

ζ Sagittae XIX.^{h} 45^m, N. 18° 53′, mags. 5, 10; separation 8″·6.

α^1, α^2 Capricorni XX.^{h} 12^m, S. 12° 51′, mags. α^1 4.5, α^2 3·8 ; naked eye double, separation 373″, very easy with opera glasses.

γ Delphini XX.^{h} 42^m, N. 15° 46′, mags. 4·1, 5·0 ; separation 11″·8. Very pretty double for small telescopes; brighter component yellow, the other light green.

Nebulæ, &c.—Dumb Bell nebula in Vulpecula, nearly 4° due north of γ Sagittae. Rather faint object in a 3-inch.

(M 8) Cluster in Sagittarius; large luminous field of small stars; fine object in pair of field glasses. About a degree E. of the star 4 Sagittarii and near to the present position of Uranus.

MESSLER, of Berlin, Germany, and Gaumont, of Paris, France, have finally succeeded in combining the graphophone and the biograph so that perfect synchronism is attained. It is now possible to see the pictures of a cavalry drill and hear the commands as they issue from the officer's lips. A singer accompanies her gestures with the proper words and tones, creating an illusion so perfect as to make it in many cases almost impossible to believe that what is seen is not life itself. It is hoped that the invention may be so developed that it will be possible to reproduce on the screen scenes from all countries, accompanied with the appropriate sounds and languages. The educational value of such a performance would be much greater than that of the unaccompanied, silent biograph.